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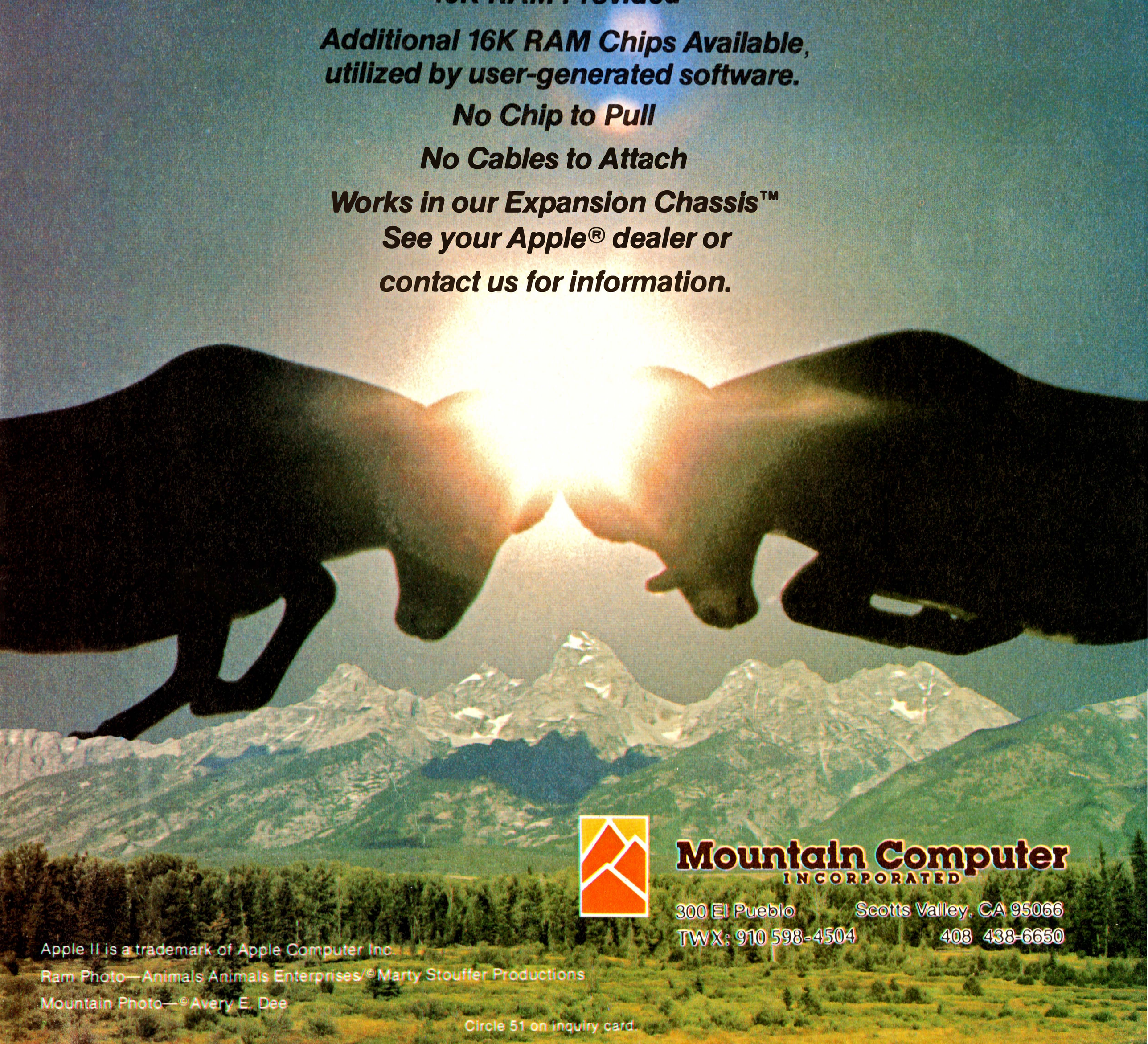

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POPULAR COMPUTING™

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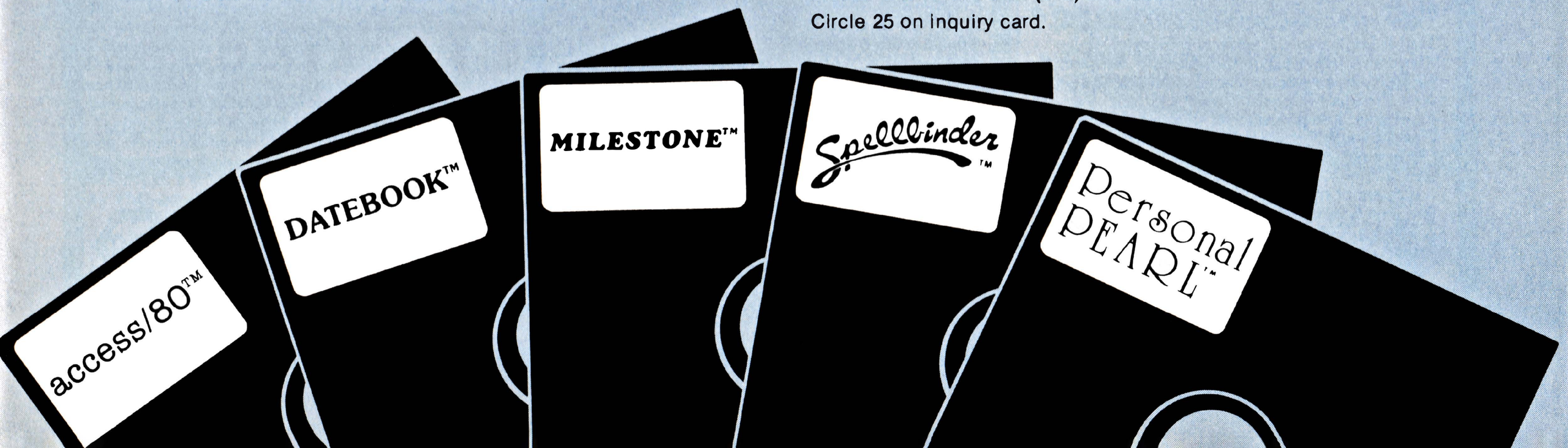

Popular's View

Minding Your Business with a Computer

Have you ever tried to fit a floppy disk into a stocking?

As depicted on this month's cover, even Scrooge has discovered that a good software utility program can perk up a bleak office. It might be just the thing for all those business people on your shopping list. The right programs and peripherals can spell increased efficiency for a company and fewer headaches for the men and women involved.

Choosing the right computer is, of course, the most important step of all. IBM has just made that decision more difficult by introducing its new personal computer (see page 52). It's hard to overestimate the impact of this new bid in the small-computer sweepstakes. One particularly felicitous feature of IBM's marketing strategy is its recognition and encouragement of the existing software "cottage industry"—that group of pioneers who wrote the programs that legitimatized small computers. Happily, wheel-reinventing is not in the works from IBM.

Elsewhere in this issue, staff editor George Stewart tells how to pick the best printer for your computer applications (see page 84). And there's a review of VisiCalc, the electronic "worksheet" that helped put popular computers on the business-community map. Is it still the best program for the job, or should you consider a newer program, such as SuperCalc? See page 34 for a complete discussion.

We've also included an investigative report on the competency of computer salespersons (page 58); a discussion of the Radio Shack Model II computer, one of the most popular small-business computers (page 16); and we've taken a look at the pros and cons of leasing computer equipment (page 30).

We hope that you and your computers have a very pleasant holiday. And we wish you an absence of any "humbugs" in your programs.

Chris Morgan
Editor in Chief

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* * *

In a couple of months MTC will introduce the successor to AIDS-III/CALCS. It is called AIDS/P™ and is based on MTC's PRIMAL™ (Practical Relational Information Management Applications Library), a powerful system for PRIME minicomputers. AIDS/P features the best of the critically acclaimed AIDS-III/CALCS but is probably an order of magnitude beyond it in power. It will be first made available to AIDS-III/CALCS owners (for an upgrade charge), then to the general public. Price will be in the $200-$300 range.

* * *

Effective September 1, 1981, Metatronics Corporation became a subsidiary of MTC. Metatronics will carry the complete MTC product line in addition to its own. Order processing and fulfillment departments have been combined to improve service response levels. MTC's superior software and supplies marketing, and Metatronics exceptional peripheral offerings should prove to be a fomidable combination. (Sorry guys, if you can't beat us, join us . . .)

* * *

MTC now offers a more complete selection of diskette products (ad deadlines prevented inclusion in anything but this column). New manufacturers are MAXELL and 3M. Definitely call for specific information. For example, MAXELL Brand 5¼" diskettes in a PLASTIC LIBRARY CASE are only $34.95 for a box of 10! SCOTCH Brand diskettes are comparably value-priced. MTC is also introducing its own PARAGON™ Brand media products. The intent is to offer a super-high quality product at a very competitive price. For example, a box of 10 single-sided, soft-sectored, double-density, 100% certified diskettes with HUB RINGS is only $24.95! A full line of products (including HEAD CLEANING KITS, etc.) will be offered. The PLAIN JANE™ (almost 200,000 units sold) diskette line will become part of the PARAGON™ MAGNETICS operation (but don't quote us verbatim).

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Ask Popular

Ask Popular is a monthly column in which we answer general questions about small computers. Send your questions to: Ask Popular, POB 397, Hancock, NH 03449.

Q Every time I read a computer-related article or advertisement, I see the terms "RAM" and "ROM." What exactly do they mean?

A Both are acronyms for different types of computer memory chips (tiny electronic integrated circuits).

RAM stands for random-access memory. It's also referred to as read/write memory. RAM is the internal memory where program instructions (software) and program results are stored. The contents of a memory location in RAM can be changed by the software. It's "random access" because the computer goes directly to the data it needs, as opposed to serial access, where the computer must start at the first memory location and go through every one in order to find what it wants.

ROM stands for read-only memory. It is a program stored in a form that can be read by the computer but can't be changed. ROMs are normally used to store the information the computer needs to get itself running when it's first turned on (the bootstrap). As well, often-used software is stored in ROM. Other variations are called PROM (programmable read-only memory) and EPROM (erasable programmable read-only memory). These are used mainly by experimenters.

Q What's an operating system? Why do you need one?

A An operating system is a group of programs (software) that acts as the "traffic cop" between the hardware, the applications software (software designed for a specific purpose), and the outside world (you). The operating system gets information from peripheral devices, such as the keyboard and the floppy disk, assigns tasks to the microprocessor, allocates the time needed for each task, and makes sure the results are communicated to the outside world, through the video screen and printer. The operating system also contains a number of "housekeeping" programs (called utilities) that let you, for example, make backup copies of programs or copy files. In short, without an operating system, a computer can't do anything.

Many operating systems are available for personal computers. Unfortunately, most manufacturers have developed their own systems and this sometimes creates problems because an application program must be written for a specific operating system. The result is that most programs written for a specific computer are not "portable," which means they can't be run on a different brand unit. There is some hope for standardization, however. Many small computers now run the CP/M operating system, which stands for Control Program for Microprocessors.

Q Some automobile manufacturers advertise that their cars have computers in them. Is this true and what do they do?

A Over the next few years, you're going to see more computers used in cars, although probably not in an immediately recognizable form. Right now, computers are used for controlling the engine by monitoring fuel flow, air/fuel mixture, and timing. This means a more efficient engine, better gas mileage, and less service. Many cars also have sensors that can be hooked up to a diagnostic computer for service. Some of the more expensive cars have digital speedometers and gauges.

There's more than a hint of "big brother" in some of the automotive computer applications. Recently, officials of one of the major domestic automobile manufacturers admitted they were using a microprocessor in their top-of-the-line model to check if the owner was having the oil changed regularly, starting the car after warning lights told him not to, or driving at excessively high speeds.

It won't be long before computers will be used extensively in all cars. (For an in-depth look at this fascinating subject, see the article by noted auto writer Marc Stern in next month's *Popular Computing*.)

Q What's a computer language?

A It is any means of communication whereby a computer can be told what to do and how to do it. At their most basic level, computers only understand binary (combinations of 1s and 0s) code. Early computer programmers spent their days writing long lists of 1s and 0s. It was a boring, inaccurate and excruciatingly slow process. (It often took hours to tell a computer to add two numbers.)

Before long, programmers devised a better way to program, using assembly language. Although assembly language is faster to write, you still need an intimate knowledge of the way a computer works in order to use it.

The concept of a high-level language—language close to plain English—was then born. FORTRAN and COBOL were the first developed, and are still used extensively today, though mainly in large computer installations. A special program (called an interpreter or compiler) translates the high-level language into the binary form the computer understands.

The most commonly used high-level language for personal computers is BASIC (Beginner's All-purpose Symbolic Instruction Code).

Continued on page 10

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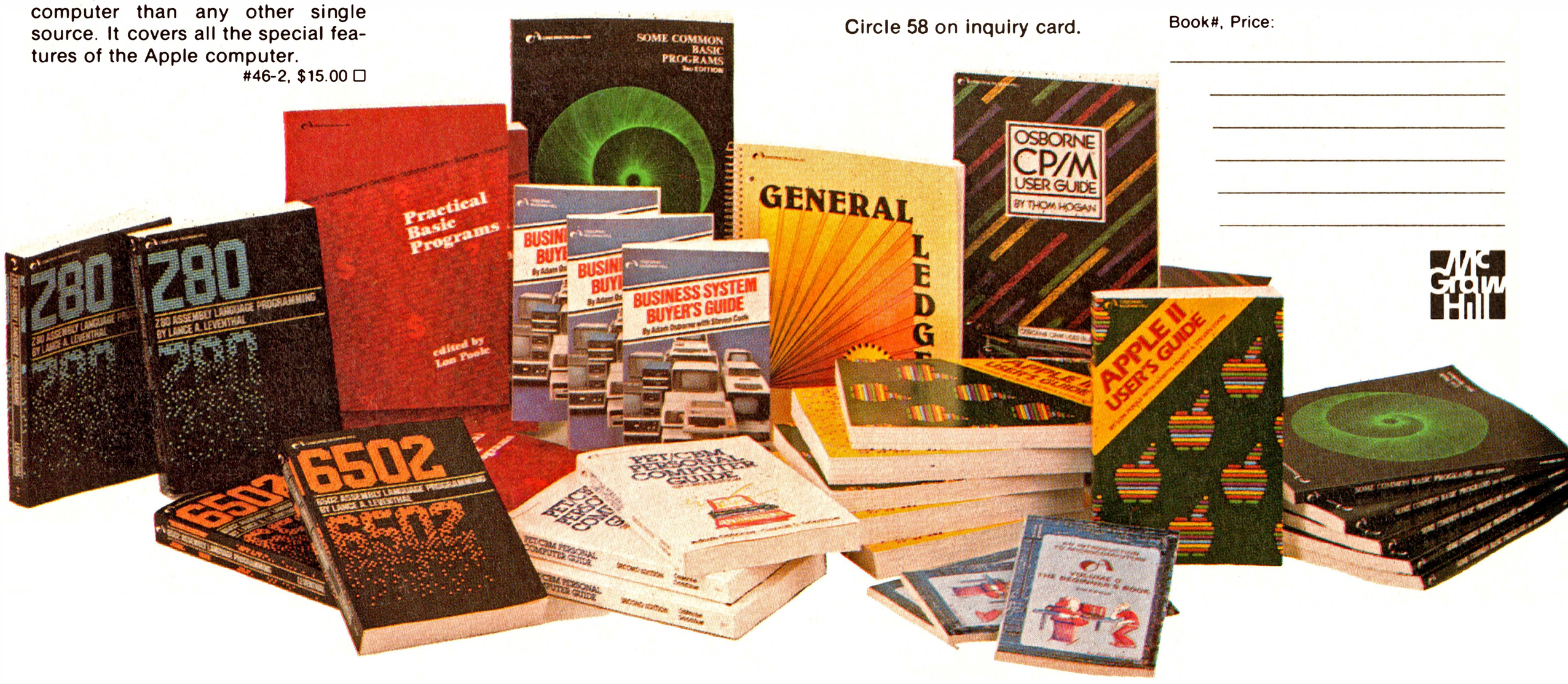

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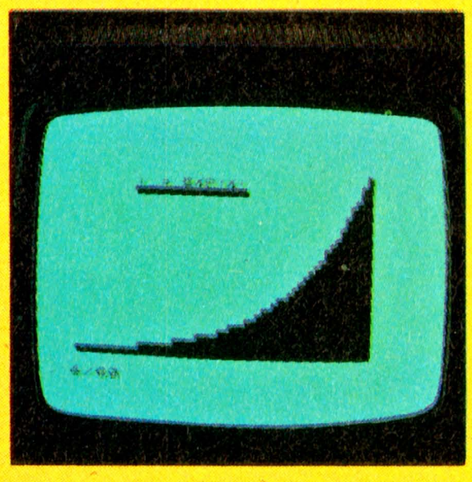
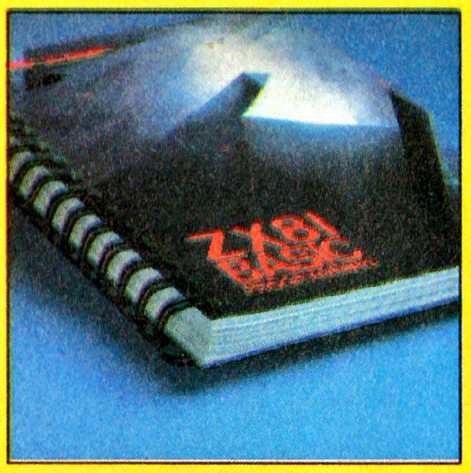


NEW SOFTWARE: Sinclair has published pre-recorded programs on cassettes for your ZX81, or ZX80 with 8K BASIC. We're constantly com with new programs, so we'll send you our latest software catalog with your computer.

ZX PRINTER: The Sinclair ZX Printer will work with your ZX81, or ZX80 with 8K BASIC. It will be available in the near future and will cost less than $100.

16K MEMORY MODULE: Like any powerful, full fledged computer, the ZX81 is expandable. Sinclair's 16K memory module plugs right onto the back of your ZX81 (or ZX80, with or without 8K BASIC). Cost is $99.95, plus shipping and handling.



ZX81 MANUAL: The ZX81 comes with a comprehensive 164-page programming guide and operating manual designed for both beginners and experienced computer users. A $10.95 value, it's yours free with the ZX81.

The $99.95 personal computer.

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If you really want to save money, and you enjoy building electronic kits, you can order the ZX81 in kit form for the incredible price of just $99.95.* It's the same, full-featured computer, only you put it together yourself. We'll send complete, easy-to-follow instructions on how you can assemble your ZX81 in just a few hours. All you have to supply is the soldering iron.

How to order

Sinclair Research is the world's largest manufacturer of personal computers.

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To order, simply call our toll free number, and use your MasterCard or VISA.

To order by mail, please use the coupon. And send your check or money order. We regret that we cannot accept purchase orders or C.O.D.'s.

CALL 800-543-3000. Ask for operator # 509. In Ohio call 800-582-1364. In Canada call 513-729-4300. Ask for operator # 509. Phones open 24 hours a day, 7 days a week. Have your MasterCard or VISA ready.

These numbers are for orders only. For information, you must write to Sinclair Research Ltd., One Sinclair Plaza, Nashua, NH 03061.

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	PRICE†	QTY.	AMOUNT
ZX81	$149.95		
ZX81 Kit	99.95		
8K BASIC chip (for ZX80)	39.95		
16K Memory Module (for ZX81 or ZX80)	99.95		
Shipping and Handling	4.95		$4.95
To ship outside USA add $10.00			
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† U.S. Dollars

Ask Popular

Q **What's a byte?**

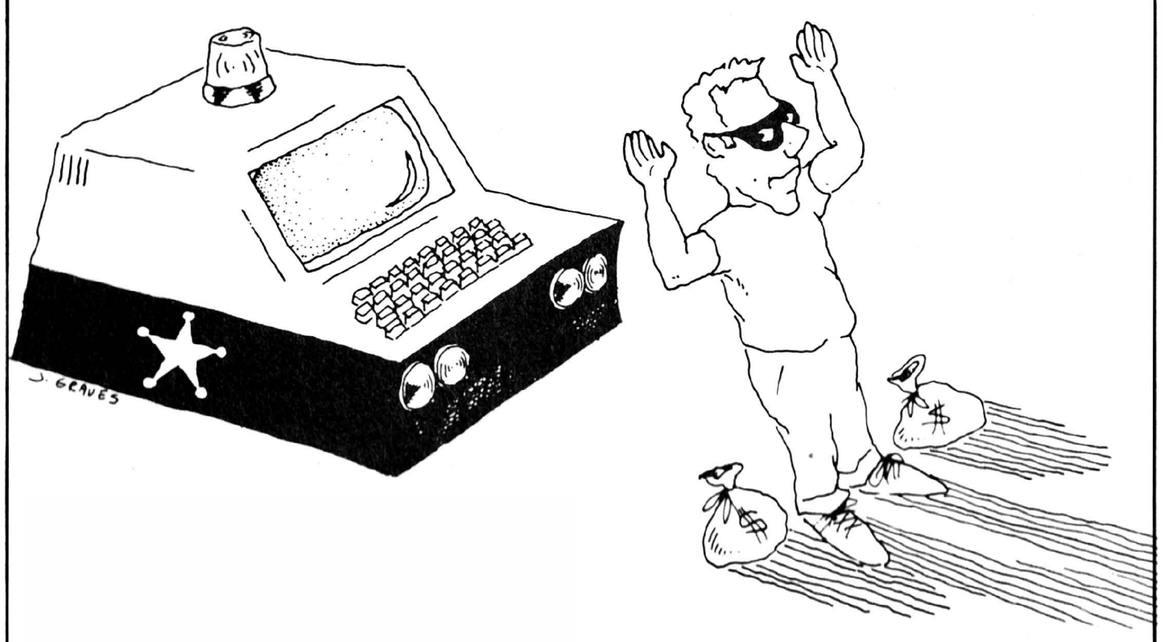
A In addition to being the name of *Popular Computing's* sister magazine for technical types, a byte is the basic unit of storage in a computer. This holds true for almost all computers, from pocket units to IBM mainframes. A byte is a set of (usually) eight switches, each of which may be on or off. Each switch is called a bit. There are 256 different combinations of on-off bits in a byte, so a byte can represent a number from 1 to 256, or any of 256 different quantities. Two or more bytes are needed to represent a larger range of numbers. Computers must store text as well as numbers. This is usually done by means of ASCII (American Standard Code for Information Interchange). ASCII assigns a number to each of 96 different characters, including the alphabet, punctuation marks, and special symbols. For example, the code for the letter A is 65. Therefore, to store the letter A, the computer puts the number 65 into one byte of memory.

Q **Why are computers so expensive?**

A You might find this hard to believe, but they're not. In fact, in this era of double-digit inflation computers are one of the few things that are consistently going down in price while giving you more capability. Today's $1000 computer has more computing capability than the million-dollar computers of 25 years ago.

We should, however, inject a bit of harsh reality. Many people we talk to seem to be waiting for the day of the $25 computer. Although pocket calculators went from $800 to $10, that just won't happen with personal computers. It's now getting to a point where the cost of labor and materials won't allow personal computers to go much lower. More and more small computers are appearing in the $300 to $500 range. That's probably as low as they're likely to go. (Although we'd like to be proved wrong on that point.) ■

Update



Computer Helps Nab Crooks in Texas

With the aid of a computerized log, police in University Park, Texas, have been able to chart burglary patterns and predict fairly well where a criminal will strike next.

The computer in this small Dallas suburb assimilates details of each crime and descriptions of suspects from police reports. When detectives notice something unusual, they log onto the computer to check, for example, whether a red Pinto has been seen leaving the scenes of several crimes.

"Officers frequently switch beats and schedules, and they miss information on one crime that might help solve another," said Josh Dowdell, a computer company president and part-time police officer who developed the computer program.

Dowdell once worked in the computer department for Dallas police. There, he observed how big-city police use computers to solve crimes. Though most smaller departments can't afford expensive mainframes, he thought they could somehow devise a smaller system. When he moved to University Park, he discussed the possibility of a computer log with Chief David Beidelman, also formerly of the Dallas police force. Beidelman liked Dowdell's idea, and the two developed the system they now use. While Dowdell furnished the computer expertise, Beidelman contributed the criminology information.

Since the department began using the computer, it has helped to solve many crimes that might otherwise have remained puzzles, according to Dowdell. For example, after calculating where a burglary was likely to happen, police staked out the location. When the suspect arrived, he was met by the police, arrested, and subsequently charged with committing 150 burglaries and stealing $250,000 worth of merchandise.

Another thief whose patterns were calculated by computer was followed by police officers for several weeks. Each time the would-be burglar cased a house or store, he discovered that plainclothes cops had beat him to the scene. Eventually, he tired of the game and moved on to another city, where he was later arrested.

IBM Enters the Personal-Computer Market

For years, computer-industry pundits wondered who would become the IBM of personal computers. Now they apparently have the answer: IBM.

The price and performance capabilities of the recently introduced IBM Personal Computer could send the industry reeling. (See Stan Miastkowski's "A Close Look at the IBM Personal Computer," on page 52.) Prices range from $1565, for a basic home system attached to a cassette player and television set, to about $6000, for a fully stocked system with advanced color-graphics capabilities. Because the machine uses a 16-bit microprocessor, its computing power and memory capacity far exceed that of most other personal computers, which use 8-bit microprocessors. However, presently available software doesn't take advantage of the computer's advanced features.

The system, which comes with a 90-day warranty on parts, became available in October. It's sold through Computerland stores, Sears, Roebuck and Company's new business-machine stores, IBM Product Centers, and directly by IBM's Data Processing Division.

Versions of such popular programs as VisiCalc, a financial-modeling package by Personal Software, Inc., now run on the machine. Other programs include the EasyWriter word-processing system from Information Unlimited Software, Inc., and three accounting packages from Peachtree Software, Inc. Also available is the highly popular fantasy game, Microsoft Adventure.

Additional software packages will be marketed under the IBM name through a royalty arrangement with program writers. The company says users also will be able to transfer hundreds of existing programs to its personal computer with "minimal modifications" once two independent program-handling systems are adapted.

Among the system's highlights are an 83-key adjustable keyboard, up to 262,144 characters of user memory, graphics capabilities in 16 colors, and an adjustable printer that provides 12 type styles and prints in two directions at 80 characters per second. The system connects to any 120-volt AC power outlet and is cooled internally by a low-speed fan.

The basic system consists of the keyboard and system unit. A more typical system for home or school with a memory of 64 K bytes, two disk drives, and a black-and-white monitor costs $3005. An expanded system for business with color graphics, two disk drives, and a printer costs $4500.

The computer was developed at IBM's Information Systems Division in Boca Raton, Florida. All the components were manufactured in the United States except the printer, which was produced in Japan, and the display unit, which was made in Taiwan.

Computerized Answering Service

If answering services conjure up images of cramped offices jammed with gum-smacking operators counting the number of rings on incoming calls,

the Answer Network may be what you've been waiting for.

An automated, computerized answering service, the Answer Network also provides the following services: word processing, Telex/FAX, electronic mail, mailing-list preparation, and order entry. Operators are seated at computer terminals with individual phones and as calls are received, client files are punched up on a display screen. The file includes instructions for taking a client's calls, the type of business owned, business address and office hours, the client's location, and a telephone number where the client can be reached in an emergency. Special instructions can be attached to the file as well.

Messages are typed on the operator's keyboard and stored in the computer's data base. When a client calls in, the computer automatically retrieves messages.

The Answer Network rates average between $50 and $125 a month, depending on the amount of computer time used. The firm is located in Santa Ana, California.

Foundation Promotes Educational Software Development

Soon after personal computers began appearing in large numbers, educators flatly predicted that the microcomputer would revolutionize teaching and learning in American schools. But the machines have failed to live up to their original billing, in large part due to a serious lack of appropriate software. The Foundation for the Advancement of Computer-aided Education is attempting to unleash the tremendous potential of microcomputers. In the past two years, the foundation has awarded about $625,000 in grants to assist educators in the development of innovative educational software.

In January 1979, Apple Computer started the foundation, which until this year was known as the Apple Education Foundation. Apple remains the main contributor, but the name change reflects the organization's desire to establish a more neutral image and broaden its base of donors.

The foundation is now an independent group and is awaiting receipt of nonprofit tax-exempt status from the federal government. Still, the foundation has never awarded a grant to anyone who proposed writing software on a microcomputer other than an Apple. The foundation insists that there are no restrictions prohibiting the support of proposals using Commodore or Radio Shack equipment, for example.

The foundation provides only hardware—computers and peripherals—with no funds available for salaries or office facilities. Grant recipients have approximately 16 months to complete their projects, and they are permitted to keep their gear when the project is completed.

Program authors receive copyright protection, while the foundation gets the distribution rights to the software. To date, no decision has been made on how to compensate program developers for the sale of their work.

Interest in the foundation has grown dramatically. In the past two years, it has distributed more than 21,000 brochures describing the application process. Requests for the brochure pour in at a rate of nearly 500 per month.

"Decisions are made on the merit of each proposal, rather than on the subject matter," comments Peggy Redpath, administrator of the Cupertino, California, foundation. "There tends to be a higher number of grants made in the fields of math and science, but only because we receive more proposals in that area." The foundation maintains a strong interest in special-education programs and tries to direct 15% of its funds into that area.

Among the proposals that received funding this year are programs for handwriting skills, reading Russian, elementary music instruction, college reading, and the teaching of atom structures. The foundation encourages instructional programs for all age levels and in all fields. Awards are made on the basis of uniqueness, potential use of the final program, degree of benefit to education, and capability of the grantee to carry out the project.

Children's Television Workshop Enters Electronic Publishing

Mix Sesame Street and Apples and what do you get? A new recipe for software developed by the creators of Big Bird and the Children's Television Workshop (CTW) and Apple Computer Inc.

Spawned by Sesame Place, an educational play park outside of Philadelphia (also a Sesame Street spin-off), the programs were written by a CTW team headed by Joyce Hakansson. Hakansson is the mastermind behind the park's Computer Center, where more than 50 fun programs are online for children and adults. The 20 new programs are the "best of our Sesame Place ones, tailored for the public audience," said Hakansson.

Sporting color graphics, including the Sesame Street Muppet cast, and sound effects, the programs will come four to a disk at approximately $50 each. Designed to teach children about computers as well as improve reading, spelling, and math skills, the programs are CTW's first venture into electronic publishing.

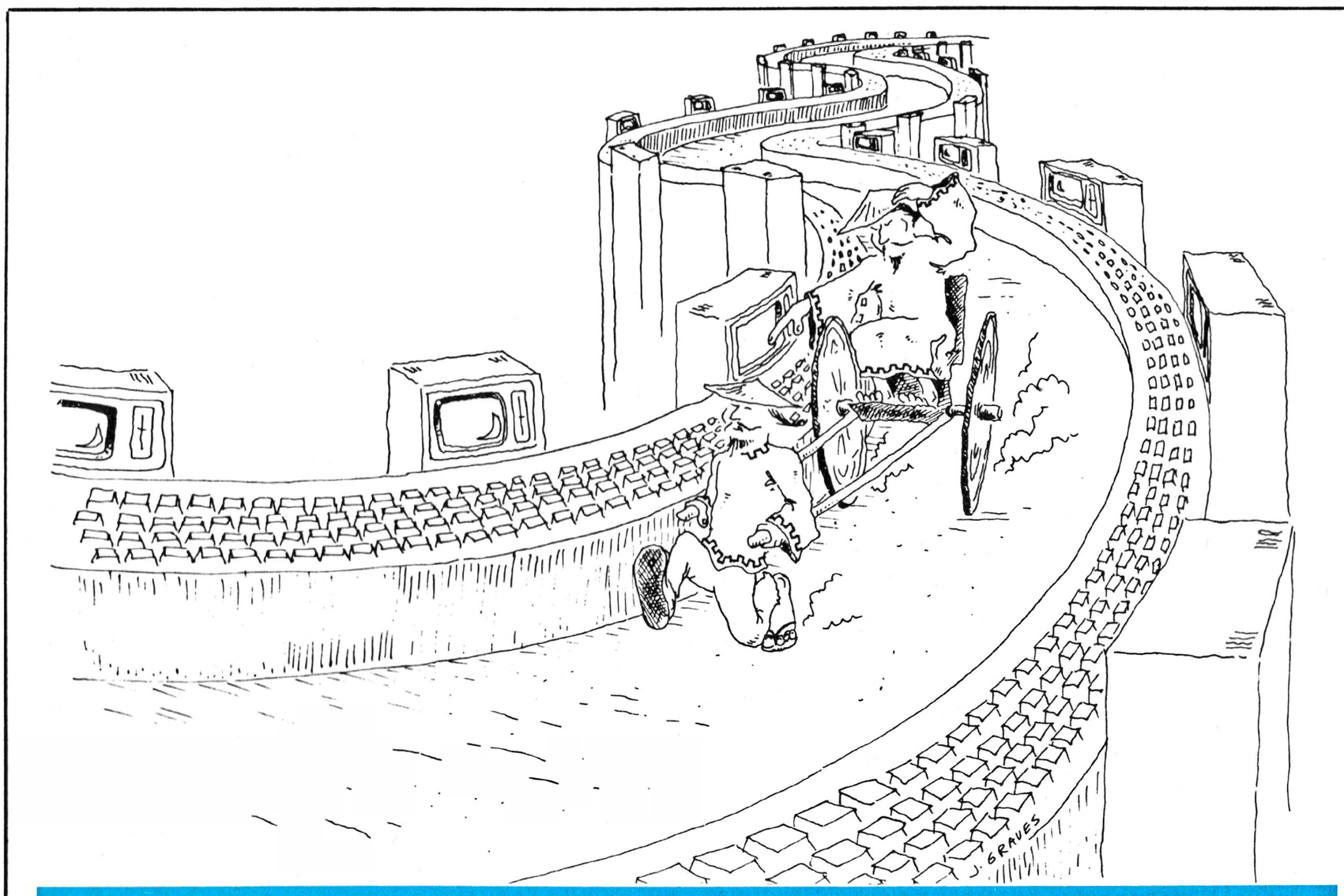
Apple plans to market the programs through the company's direct-mail catalogs and in computer retail stores.

Electronic Newspaper

Stop the presses! Radio Shack and the Tiffin, Ohio, *Advertiser-Tribune* have developed what they claim is the first privately owned electronic newspaper.

To read the latest scoop, subscribers must have a Radio Shack Videotex terminal or software that allows their computers to act as terminals, a color television, and a modem. Then, the subscriber simply turns the terminal on, submits an access message, and chooses a topic from a list of reading material.

According to a Radio Shack spokesman, the electronic newspaper will actually be more immediate than that in the normally distributed editions, since news will be indexed in the computer bank within minutes after reporters file stories.



Computerizing Chinese Characters

How do you put 50,000 Chinese characters on a standard computer keyboard? This question is puzzling computer and language experts working to bring Chinese data processing up to par with the rest of the world.

Unlike the English alphabet, each Chinese character represents an idea, not a sound. To be considered literate in China, you must know at least 2000 characters while the college-educated understand 5000. Developing a usable keyboard and coding schemes to handle such a complex language are the major obstacles. But after years of study, some answers are beginning to emerge.

Computer experts at IBM have developed a keyboard with a capacity to represent more than 2000 characters. On the main keyboard, each key can produce any of 12 different characters. A smaller, 12-digit keypad allows you to specify which of the 12 characters is to be used. The system includes a high-resolution display screen to show the complex Chinese characters.

Along with the unique keyboard, IBM has developed software that processes information in terms of two bytes instead of the usual one, which allows thousands of character combinations in place of the standard 256.

Attacking the coding system instead of the keyboard, Wang Laboratories has developed the Ideographic Word Processing System, which operates in Mandarin and Japanese. Wang's system handles 10,000 characters by assigning each a six-digit identification number. The identification numbers are selected on the basis of the character's shape. A standard disk can store up to 137.5 million characters. To operate the system, 297 codes and 15 usage rules are needed.

Using the traditional spatial separation of Chinese characters into four quadrants, Cornell University's Paul King has developed a 12-digit keyboard to code Chinese characters into a computer. Each of the 12 digits signifies a basic character shape. By selecting up to four of the 12 keys, users can define an entire character. When shapes are similar to other characters, the system uses linguistic rules to identify the correct one. If a specific language rule cannot identify the desired character, the remaining characters are displayed on the video screen and the user manually selects his or her choice. The Cornell system handles 2500 words and additional vocabulary sets are now being developed.

Other tactics for handling the language include an electronic tablet system to recognize handwritten characters. Defined as a "natural data-entry system," the tablet is still in the experimental stages at IBM's Thomas J. Watson Research Center. There is also an attempt to alphabetize the Chinese language for use with Latin-alphabet-based computers. Called the Pinxxiee System, the project is being developed by H. C. Tien for the Michigan Institute for Psychosynthesis, a foundation aimed at cross-cultural union between East and West.

Robotic Sales

Roboticom Limited, Inc., a Salt Lake City subsidiary of Digital Products Corporation, has produced a robot salesperson that dials phone numbers, makes sales pitches, takes orders, and gives a daily printout of its endeavors.

Specializing in futuristic inventions, Roboticom claims the desk-top sales agent, named Telsol, is less costly than its human counterparts. Telsol works long hours—without breaks—and it doesn't get discouraged when customers hang up. In fact, it responds with a pleasant "thank you," and goes on to the next number listed in its memory bank.

Voice-actuated, Telsol begins its promotional pitch only after the person answering the telephone opens the conversation. It then tape-records responses. At the end of the day, the computer prints out how many calls were made, and which, if any, went unanswered. Telsol sells for $8965 with printer and software.

Producing Concordances by Computer

Thanks to computers, putting together a biblical concordance, an alphabetical list of principal words and all their references, is no longer an overwhelming task. What took decades to do was recently completed by two teachers in about 250 hours.

John Kohlenberger III and Edward Goodrick, professors at the Multnomah School of the Bible, wanted to produce a concordance of the *New International Version*, the most widely read bible in the English-speaking world. They narrowed the list of usable words from more than 1 million to 12,800, which are contained in some

250,000 passages. Each verse in the newly published book, *The New International Version Complete Concordance*, has at least eight references.

Kohlenberger says concordances are used by pastors, theologians, and students who want to review all the passages pertaining to certain biblical topics.

The new concordance is the first of several works Kohlenberger and Goodrick have planned. Next, they envision concordances with references to the original Hebrew, Latin, and Aramaic translations.

French Government Aims to Put a Computer in Every Home

The French government hopes to have a computer online in every household by the end of the century. The Mitterrand government is conducting an experiment that will eventually place videotex systems in 2500 volunteer homes. The volunteers represent a cross-section of the French population, varying in economic, academic, and professional backgrounds.

Teletel 3V is part of the larger Telematique program that is expected to computerize directory assistance via videotex terminals. Operating on color-television sets or videotex terminals and normal telephone lines, Teletel will provide services similar to those of American telecommunication networks, such as transportation schedules and newspaper articles. Participants will select the services they want from about 170 companies and agencies and pay only for telephone time. The government is providing free hardware and is subsidizing the test project by selling videotex terminals abroad.

Professional Jurors—A Vanishing Breed

In the past, a frequent criticism of the judicial system has been the handpicking of potential jurors by individual courthouses. The criticism has focused on so-called professional jurors—friends of the court who were often favored with calls for jury duty. It is argued that when judges pick their cronies to sit on juries, the jury boxes are rarely filled with ethnic minorities or those from differing socioeconomic backgrounds.

Today, that criticism is vanishing, thanks to computers. In 70 of the nation's 96 federal district courts, computers are now compiling lists of jurors and, in some instances, issuing summonses and pay vouchers.

"I couldn't pick you for jury duty if I wanted to," said W. Farley Powers, Jr., clerk of the U.S. District Court for Eastern Virginia. Powers's court was among the first in the nation to turn to computer selection of jurors.

Powers said the administrative office of U.S. Courts has emphasized computerized selection. The reasoning is simple: it's faster, cheaper, and not open to attack by attorneys.

Before his court turned to computers, Powers hired college students to pore over voter registration books, club and civic league membership lists, and telephone directories to compile a list of prospective jurors.

"The computer does in three days what it took the college kids and my staff three months to do," said Powers.

Every two years Powers purchases a computer tape with the names of all registered voters in Eastern Virginia. The list is run through a General Services Administration computer in Washington, D.C., that randomly selects the names of prospective jurors.

Boot Camp May Include Video Games

The U.S. Army is discussing the possibility of using video games to train soldiers. According to Pentagon brass, many skills learned while playing computer games are similar to those achieved in field training.

Traditionally, soldiers have honed their eye-hand coordination skills for operating ground weapons during field maneuvers, but those practices have become increasingly expensive. Blasting a camouflaged tank provides boot-camp trainees with aiming expertise but costs taxpayers thousands of dollars. Budget-conscious generals are now wondering if authentic rehearsals are cost-effective.

To determine whether coordination and reflexes can be developed using computer games, the Army Training Board recently gave the go-ahead for a study. But even if the military agrees to use arcade games in basic training, they will be altered to more accurately represent the armed forces' needs.

Computerized Passports Speed Travel

The U.S. Immigration Service is computerizing passport services in a bid to speed up entry into the country and to guard against entrants with illegal passports or criminal histories. The switch to computerization, however, was not based on any of those motives. According to Immigration Service spokesmen, the government is simply trying to rid thirteen customs agencies of outdated equipment. Washington, D.C., is the site of the first conversion and Chicago will be next.

More than 150,000 passports already have been imprinted with computer codes. Once the program is completed, machines will read the computer codes and process the data through a central data bank.

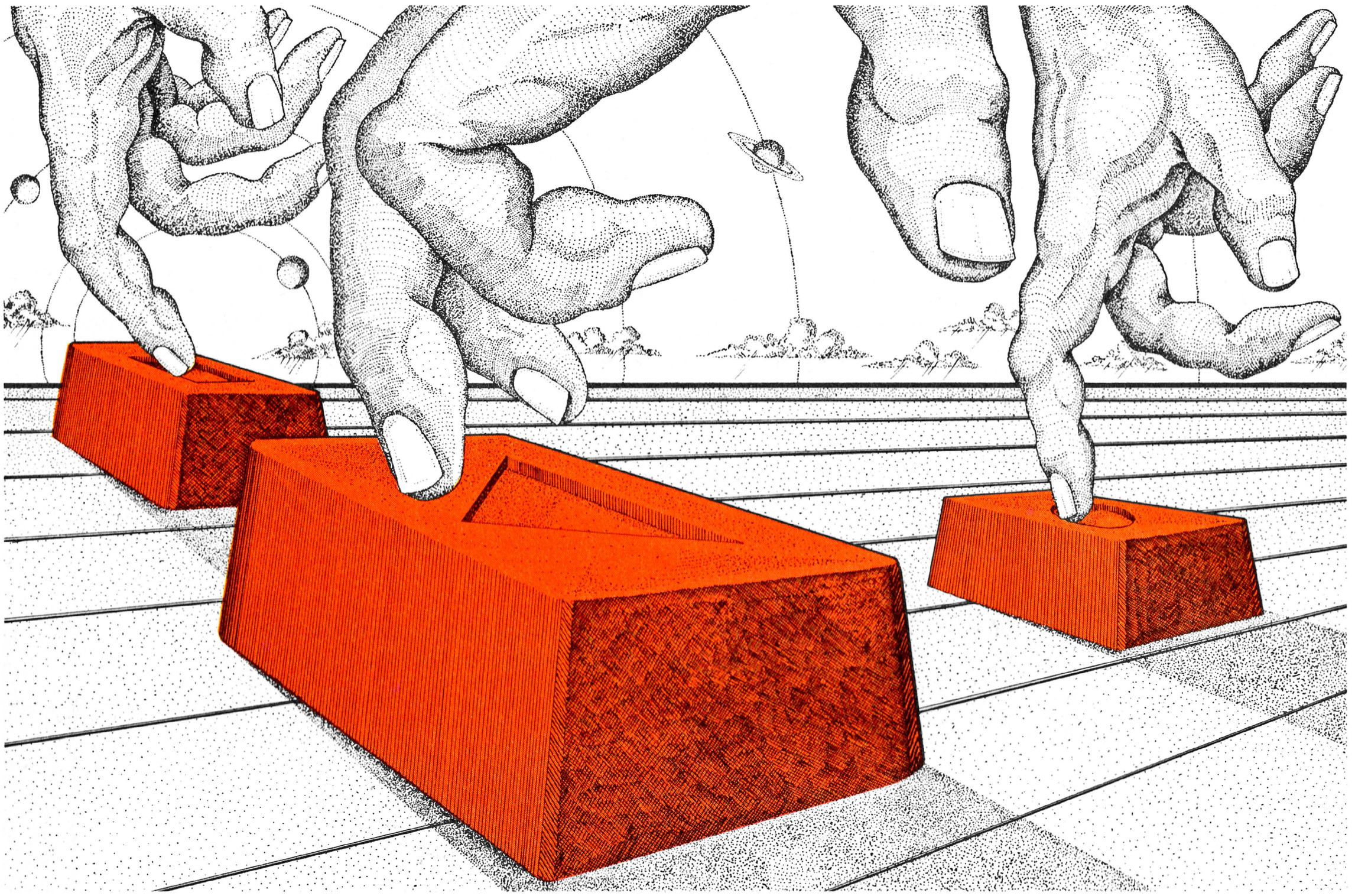
Software Review for Handicapped

Prentke Romich Company of Shreve, Ohio, is compiling its first review of software for the handicapped. It will be published next year.

Prentke Romich manufactures equipment that allows quadriplegics and the cerebral palsied to use computers. The company is soliciting software from vendors and plans to distribute it to ten rehabilitation centers for review by teachers and students. When completed, the evaluation will be compiled and published. The software will then be updated annually and placed in a registry.

Prentke Romich is working on another project to aid the handicapped in cooperation with the National Association of Special Education Directors. Using the TeleNet national telecommunications network, computerized aids available for the handicapped will be posted. The new service, called SpecialNet, will be accessible to TeleNet subscribers. ■

MANUAL DEXTERITY



The very popular *Mostly Basic* book teaches users introductory programming techniques while providing a myriad of useful applications for the home and business. Advanced Operating Systems has compiled these programs and grouped them into 3 sections. Buy any or all sections as you need them. Each section is available on cassettes for *TRS-80 Models I and III, and on diskettes for °Apple Computers.

HOUSEHOLD: Digital Stopwatch • The House Buying Guide • Amortization Schedule • Electric Energy Usage • Medical Expense Record • Recipe Amount Calculator • The Basic Diet • Message Taker • Gas Mileage Calculator • The Tarot Card Reader Game.

EDUCATIONAL: The Dungeon of Htan • Language Flash Cards • Memory Challenger • Visual Perception Test • Math 4 • The Reading Pacer • Spelling Test.

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The *MOSTLY BASIC* series from Advanced Operating Systems is now available at your local software retailer, or call 1-800-348-8558 for the nearest dealer.

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The Radio Shack TRS-80 Model II

by Stan Miastkowski

Remember the famous advertising slogan from the turn of the century: "They laughed when I sat down at the piano"? About the fellow who learned to play the piano through a mail correspondence course? The short history of Radio Shack's small-business computer brings the slogan to mind, for indeed the sages at computer corporations *did* laugh when Radio Shack first released the TRS-80 Model II some 2½ years ago.

Their laughter was short-lived.

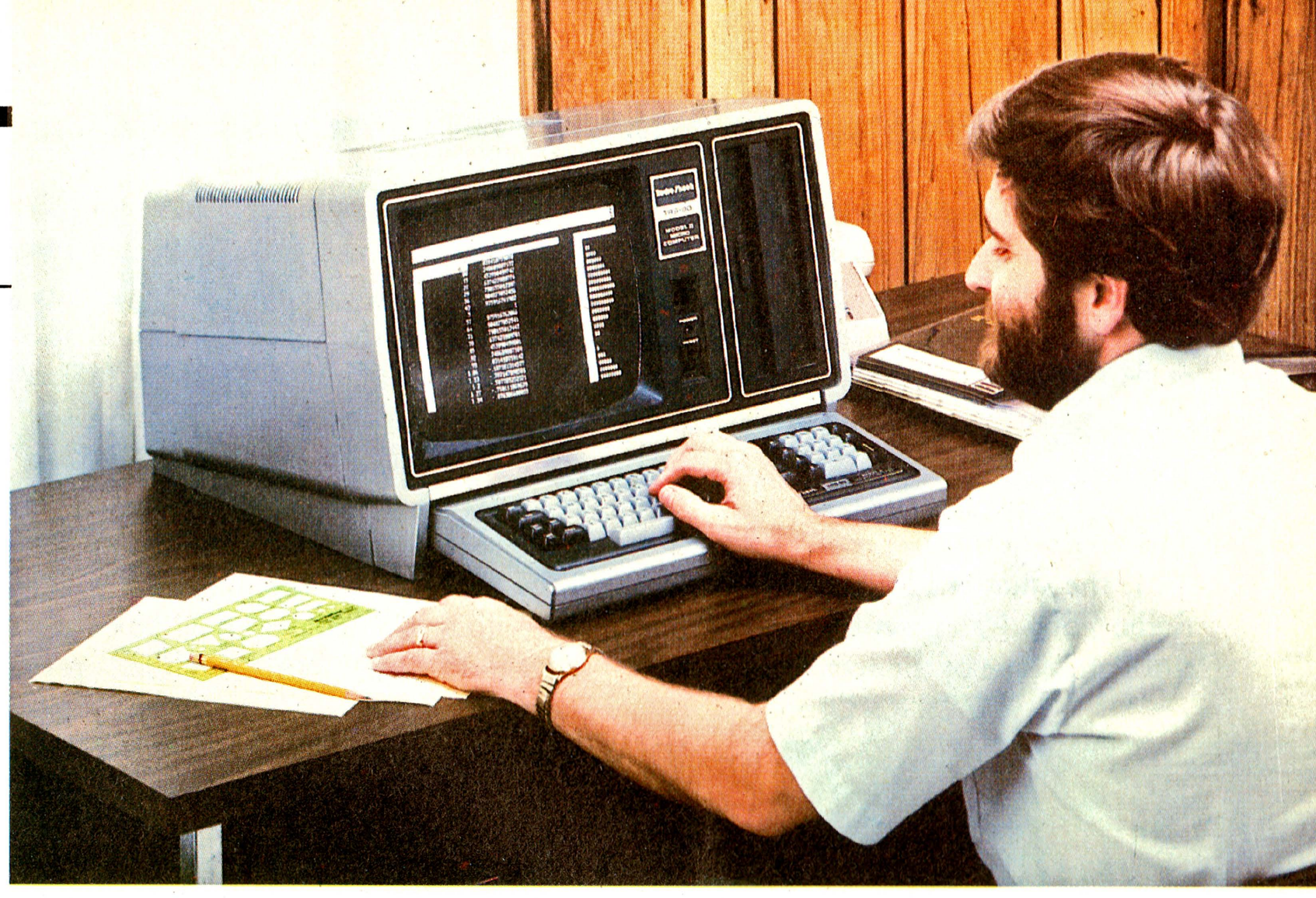
Just as the phenomenal success of the TRS-80 Model I advanced development in the small-computer industry, the release of the Model II sent sales of small-business computers soaring.

The Model II was a gamble. At a time when small-business computers were selling for $10,000 and up, the Model II appeared on the market for $3450. Sales built slowly, but the Model II quickly became a best-seller, surprising all the experts.

The Radio Shack TRS-80 Model II. The 76-key keyboard is detachable and includes a two-foot cord. Shown on the 12-inch high-resolution screen is a directory from Scripsit, Radio Shack's word-processing software package. The 8-inch floppy-disk drive appears to the right of the screen.

Model II Features

The Model II is Radio Shack's top-of-the-line system. It features many of the niceties business people have come to expect from computers. The all-in-one unit includes a built-in 12-inch black-and-white video display, a built-in 8-inch disk drive, and a detachable keyboard that can be positioned according to the operator's whim. (I'm writing this article on a Model II with the keyboard sitting in my lap.)



The TRS-80 Model II's microprocessor zips along at 4 MHz (millions of cycles per second), so even lengthy calculations are performed quickly. Both the screen and the keyboard have their own special control chips that take much of the "housekeeping" workload off the microprocessor.

The keyboard has 76 keys that are set up in the standard IBM typewriter format. Those keys that aren't normally found on a typewriter (such as Control and Escape) are logically placed, including a data-entry keyboard over to the side.

One characteristic that sets the Model II apart from other small computers is its keyboard controller—a chip that constantly checks the keyboard to see if a key has been pressed. In most small systems, the microprocessor accomplishes this task, which slows down the computation process. The extra time the Model II doesn't spend scanning the keyboard can be used for performing calculations in a program.

Keyboards in some earlier versions of the Model II were mushy: keys tended to move back and forth. But this inconvenience was corrected in later versions coming off the assembly lines in Fort Worth.

The best feature of the Model II is its display, a high-resolution black-and-white screen. This display was designed with human engineering in mind, and it uses very small dots to form upper- and lowercase characters. In fact, the screen can be used all day without incurring the eyestrain that often results from using a standard TV receiver as the video display.

The TRS-80 Model II was obviously created for a variety of business applications, though the configuration of the screen is especially good for word processing. The screen shows 80 characters across and 24 lines down. When text is set up in this manner, what you see on the screen is the same as what appears on the printed copy. This is particularly useful for composing letters and reports.

Since its introduction, the TRS-80 Model II has been criticized for its lack of color graphics. Admittedly, charts and graphs are easier to read when displayed in color, but color graphics are not essential for most business applications.

Underlining the thought the Radio Shack engineers put into the Model II, the video display also has its own controller chip that takes care of "housekeeping" chores usually performed by the microprocessor.

All about Disks

In the Model II, Radio Shack chose an 8-inch rather than the more common 5¼-inch floppy disk. Even though the system disk (the one that goes into the built-in disk drive) uses 122 K bytes of memory space just to keep the system running, there are still 358 K bytes left over. What's more, you can add up to three additional drives, each storing 480 K bytes. (To put this into perspective, if you can type 70 words per minute, it would take you over 24 hours of straight typing to fill a disk.)

If that still isn't enough memory for you, Radio Shack recently introduced a hard-disk unit, mounted permanently in a sealed container. Although it retails for $4495, the drive stores an incredible 8.4 *million* bytes, making it (on a byte-for-byte basis) much lower in cost than additional floppy disks. Besides the tremendous amount of information that can be stored on a hard disk (eliminating the necessity of continually changing floppy disks), they can load programs and data at incredible speeds. Even the largest program seems to load instantly. If you ever need to store over *32 million* bytes of data, you can add up to three hard disks.

Radio Shack's hard disk is among the first available for small computers and it will appear on the market later this month. If you'll be using a Model II in an application that requires enormous storage, the hard disk is an accessory you should definitely consider.

Heart of the System

The heart of the system, the microprocessor, is the Zilog Z80A, a faster version of the ubiquitous Z80 microprocessor used in many small computers. It zips along at 4 MHz (millions of cycles per second). This extra speed, coupled with the outboard controller chips for the video display and keyboard, means

that the TRS-80 Model II gives some of the best performance available in a low-priced computer.

The Model II comes with either 32 K or 64 K bytes of RAM (random-access memory), and I recommend that you opt for the maximum 64 K when you buy the Model II, since most business packages require that much memory.

In the matter of start-up design, Radio Shack's inventiveness shines through. Some of the software required to get the Model II up and running (the bootstrap) is stored in ROM (read-only memory). Although most popular computers lose RAM space because of the ROM bootstrap, the Model II makes no such sacrifice. Radio Shack engineers designed a way for the ROM to be switched out after the bootstrap is finished, freeing up even more memory space for program use.

Another Model II plus is power-up diagnostics. As the machine goes through its start-up, another program in ROM scans hardware, insuring that everything's shipshape and ready to go.

Radio Shack offers a full range of business software for the Model II—from General Ledger to Inventory to Financial-Analysis packages.

Traffic Cop System

The key to the usefulness and efficiency of any computer system is the operating system, since it acts as a "traffic cop," coordinating hardware and software. The operating system for the Model II is TRSDOS (pronounced *triss-doss*, and standing for "TRS Disk Operating System"). All of Radio Shack's Model II applications programs (the list is long and getting longer) are designed to run with TRSDOS. Although advanced programmers may find TRSDOS confining, it's an excellent choice for the Model II since it was made specifically for that machine.

The CP/M (Control Program for Microprocessors) operating system is also available for the Model II, although Radio Shack doesn't sell it. CP/M is the de facto standard for many microprocessors, and literally hundreds (maybe thousands) of programs have been written to run under it. Whether you want to spend several hundred dollars extra is a matter of need and preference.

If you plan on running Radio Shack's software, all you'll need is TRSDOS. Many of the applications packages offered by independent software companies also run under TRSDOS, and as the Model II becomes more popular, more software will be available. On the other hand, if you plan to use any programs written for CP/M, you should have it installed. Remember, however, that Radio Shack is reluctant to service any of its computers once they have been modified.

TRSDOS includes the usual utilities (programs that copy files from disk to disk, make backup copies of files, etc.). In addition, there are a number of commands that allow you to do some sophisticated things, although most commands would only be used by an advanced programmer.

Microsoft BASIC

Model II BASIC, by Microsoft, is an advanced version of the other BASICs Radio Shack sells with its lower-cost computers. It's compatible with other BASICs on the market. If you plan to develop your own applications software with the Model II, there are numerous advanced BASIC features such as direct and sequential access to data on disk files, the ability to execute TRSDOS commands from within a program, and error trapping (the ability to recover from errors without stopping the program).

The TRS-80 Model II offers a number

Radio Shack has recently introduced a hard-disk drive for the Model II. It's the first generally available hard disk for a small computer and is designed for applications requiring a great deal of storage. The disk (which retails for $4495) is mounted in a sealed container and holds an incredible 8.4 million bytes of data. Up to four drives can be connected to a Model II. (After purchase of the first drive, additional drives retail for $3495.)

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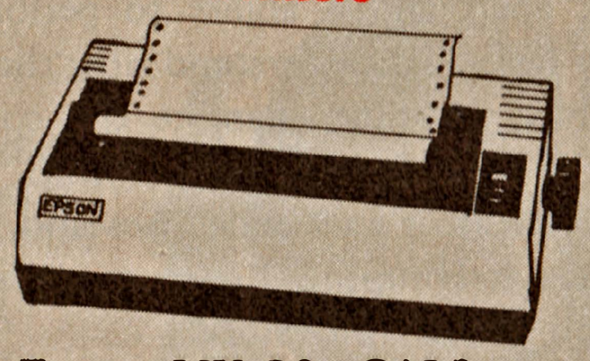

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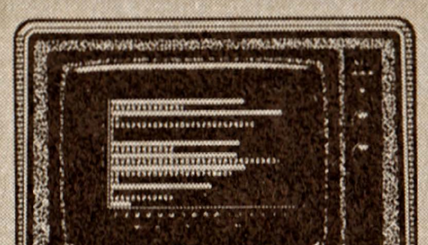

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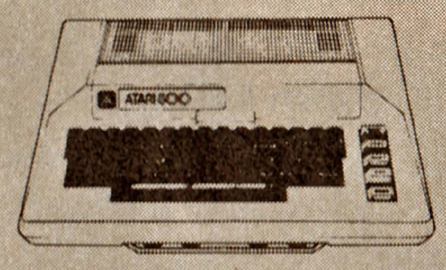

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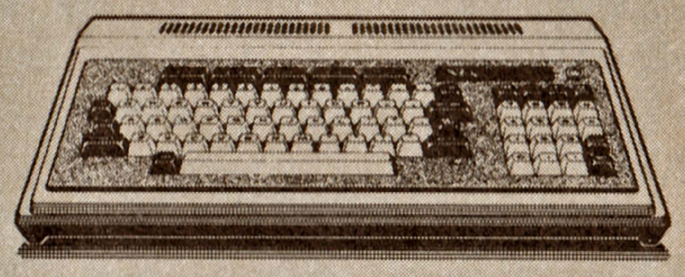

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of options for hooking up accessories. The rear panel of the computer has a connector for the Disk Expansion unit, allowing you to hook up three extra 8-inch disk drives (or the newly available hard-disk drive). There's also a connector for hooking up a peripheral that requires a parallel I/O port. Finally, there are a pair of RS-232C serial connectors—the standard interface for many printers and other accessories such as modems.

Considering its price, the Radio Shack TRS-80 Model II is surprisingly rugged. Here at *Popular Computing*, it has been used daily for over six months with absolutely no problems. (It even survived this writer's pipe smoke.) Computers have come a long way since the old days when they required climate-controlled environments.

Let's Talk Cost

As I mentioned, the basic Model II system retails for $3450 with 32 K bytes of RAM. Having 64 K bytes of RAM ups the price to $3899. In most applications, you'll find a second disk drive, which retails for $1150, useful. Two additional drives cost $1750, three are $2350. (The cost for a single add-on drive is particularly high because it's equipped with electronics for controlling additional disks.) The first hard disk and the controller, which requires special installation by Radio Shack, retails for $4495. Additional drives (up to three to increase storage to over *32 million* characters) sell for $3495 each.

In most applications you'll also need a printer. Expect to spend another $1000 to $2000, depending on whether you require letter quality or high speed. And finally, there's the well-designed software, which will add another $1000 to $2000 to your bill, depending on applications. Radio Shack has a number of prepackaged units with various combinations of hardware and software. But for a top system with accessories and printers, the price tag will be about $10,000—way below comparable systems from the majority of small-business computer companies. There's even an alternative: leasing. Radio Shack offers attractive leasing terms to qualified businesses.

Gaining Popularity

The TRS-80 Model II is quickly becoming one of the most popular computers for small-business users. Although marketing people in Fort Worth are hesitant to release exact figures of units sold, independent research firms quote figures in the tens of thousands.

Radio Shack offers substantial support for customers who buy the Model II; not only are there Radio Shack stores and computer centers in most metropolitan areas, but the company has over a hundred people answering toll-free phones. The Radio Shack customer-assistance center in Fort Worth has experts in all facets of the Model II and its software. A quick call has frequently solved what I thought to be a major dilemma. If you're in a business where it's imperative that the computer be on-line at all times, Radio Shack offers a service contract. Although it grants peace of mind, odds are you'll never need major service.

Finally, the Model II's manuals are absolutely complete. My only complaint is that they're so complete it's occasionally difficult to find what you're looking for. The owner's manual (with TRSDOS and BASIC) hefts out at over 600 pages. But don't be put off by the size. The most-used information is organized at the front of each section, leaving the advanced concepts to the people who enjoy complicated programming.

Scripsit: Word Processing Par Excellence

Since its introduction a few years ago, Radio Shack's Scripsit has become one of the most popular word-processing software packages available. With good reason, too—it's comprehensive and easy to use.

Unlike other word processors that require you to memorize long lists of commands, Scripsit allows you to type in text, make corrections and/or additions, and move text around (cut and paste) in a natural manner. Advanced commands are called by means of a "menu" which appears below the text "window," eliminating the need to hunt for the instruction manual every time you want to do something.

Another item allows you to do "global search and replace" (for instance, if Radio Shack changed the name of Scripsit, I could tell the computer to go through this review, find every occurrence of the word Scripsit, and change it to the new name).

If you use a Model II heavily, the spooler is a useful feature. It permits you to print out one document while typing another—it's especially valuable if you print lengthy documents or reports.

The list of Scripsit's features continues, and it would require a major review to explain them all. Scripsit's only weak point is its instruction manu l: it's often difficult to find an explanation of a particular item when you need further elucidation. The manual comes with a six-cassette course designed for people who have never used a computer before. The course is valuable, but only if you take the time to go through the entire thing.

As with most word processors, you can use Scripsit on a number of levels. For basic writing you don't need the advanced features, but the more you use the unit, the more features you'll find. I've been using Scripsit for a number of months (this article was written on a Model II with Scripsit) and I am only beginning *to explore the possibilities.*

As icing on the cake, Radio Shack has relea ed a new and improved version of Scripsit. Although a review copy wasn't available at the time this article was written, a Radio Shack source says that a built-in dictionary of some 100,000 words has been added. That means that the dictionary scans your completed text for misspelled words and then indicates the correct spelling. And you can add up to 2000 words to the dictionary. (Talk about an invaluable feature for lousy spellers.) Other additions are automatic hyphenation and the ability to count words (a boon for authors).

Watch for a complete review coming up in a future issue of Popular Computing.

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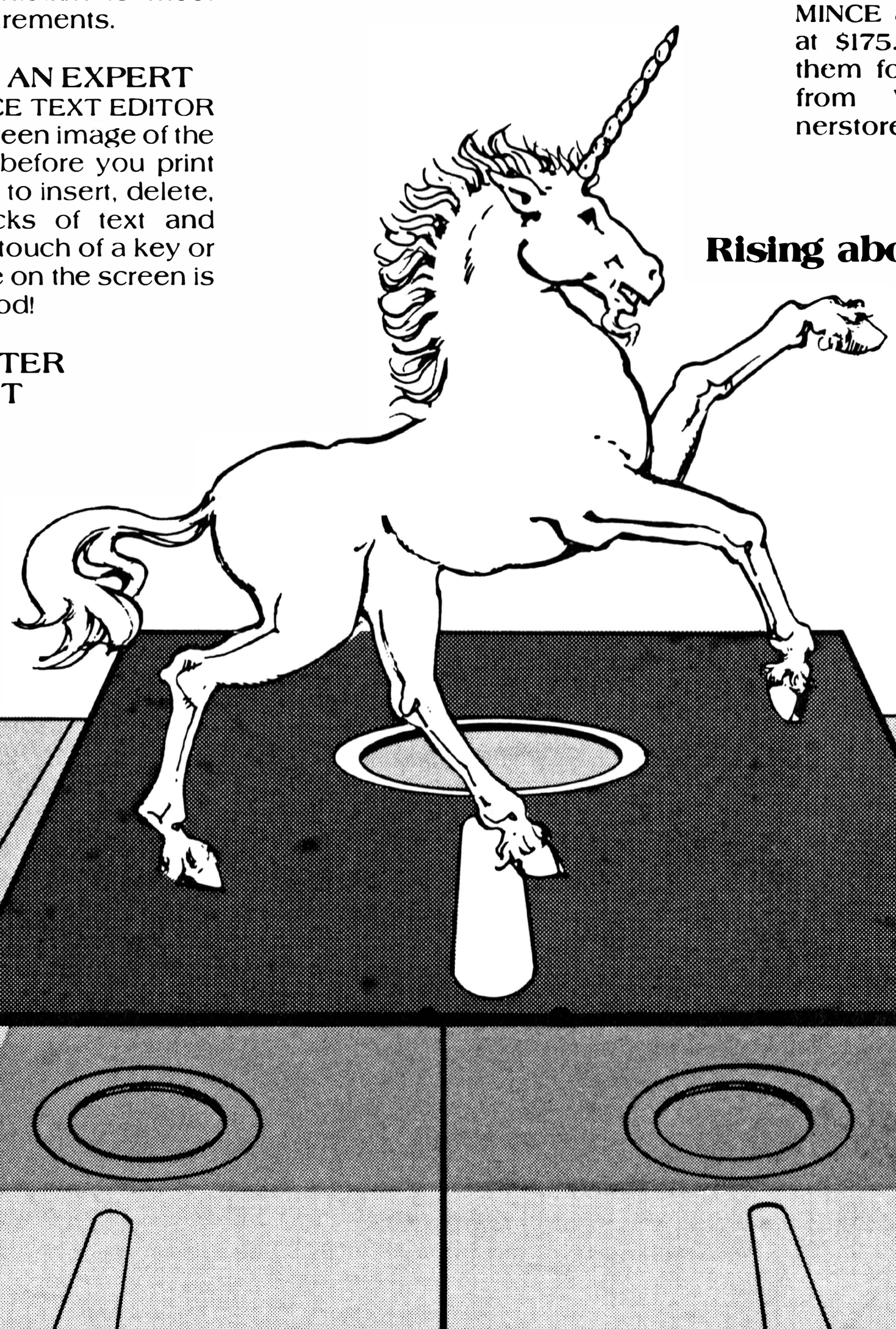

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Popular Reviews

Finally, the Software

Radio Shack offers one of the most comprehensive selections of software in the business for the Model II. With some prominent exceptions (such as VisiCalc), the majority of the software was developed in-house by Radio Shack's large and growing programming staff. For a company whose main business is hardware, Radio Shack has an unusually strong commitment to software. And Radio Shack's software is specifically patterned to exploit the Model II's advanced capabilities.

Business Packages

Radio Shack has a complete selection of standard accounting software. All the programs require a one-disk Model II with 64 K of RAM and a 132-column tractor-feed printer. Although a second disk isn't required, it does make things simpler and faster.

Inventory Management: Handles up to 3000 inventory items and 300 vendors. Projects reorder needs based on analysis of past performance and sales trends. Provides information for posting to general ledger ($199).

General Ledger: Handles up to 504 accounts and seven expense categories. Up to 11,420 entries per month. Detects automatic "out-of-balance." Generates Chart of Accounts, Trial Balance, Document List, Posting Summaries, Ledger Detail Report, Income Statement, and Balance ($199).

Accounts Payable: Features up to 500 vendor accounts and 3000 invoices on file at one time. Compatible with either cash or accrual-accounting methods. Generates a long list of reports ($299).

Accounts Receivable: Offers a complete invoicing and monthly statement-generating system. Tracks current and aged receivables. Prints statements and invoices and has an automatic-billing option. If using a system with more than one disk drive, it automatically updates general ledger ($299).

(Radio Shack also offers extended General Ledger, Accounts Payable, and Accounts Receivable software for systems with at least three disk drives.)

Payroll: Handles up to 200 employees. Calculates withholdings and prints checks automatically. On systems with more than one disk drive, it automatically updates general ledger ($399).

VisiCalc: The Model II version of Personal Software's famous "electronic spread sheet" ($299). (See the VisiCalc review, page 34.)

Profile II: A versatile data-base system that keeps track of up to 20,000 records. Allows up to 99 categories in a single record and searches for any specified category. If you are using a multidrive system, Profile works with Scripsit (see textbox) to produce form letters, reports, etc. ($179).

Profile Plus: Advanced version of Profile II ($299).

Statistical Analysis: Helps analyze data produced by other business programs ($99).

Other Programming Languages

Although most TRS-80 Model II users tend to buy prewritten applica-

At a Glance

Name: Radio Shack TRS-80 Model II

Manufacturer: Radio Shack, 1300 One Tandy Center, Fort Worth TX 76102, 817-390-3011

Price: $3450 (including 32 K RAM)

Features: Built-in 8-inch floppy-disk drive, 12-inch high-resolution video display with upper- and lowercase alphanumerics, 76-key keyboard, two RS-232C serial-interface connectors, parallel-interface connector, TRSDOS operating system, Model II BASIC.

Accessories: 32 K RAM expansion, $449; extra floppy-disk drive, $1150; hard-disk drive, $4495; printer, $1000 to $2000

System Price: $6000 to $10,000 (including 64 K RAM, additional floppy-disk drive, line printer, and "typical" business software packages)

Additional Languages: COBOL, FORTRAN, Assembler, Compiler BASIC

tions software (like those listed above), you can write programs in languages other than standard BASIC. Here are the options:

COBOL: COmmon Business-Oriented Language is a frequently used language for business applications ($299).

FORTRAN: FORmula TRANslator is primarily for scientific uses requiring many mathematical calculations ($299).

Editor/Assembler: For the advanced programmer who wants to program in assembly language, the language closest to the binary arithmetic the computer understands. Assembly language produces fast programs that take up the smallest amount of memory space ($199).

Compiler BASIC: By translating a standard BASIC program into machine language (1s and 0s) and storing it in this manner, the compiler enables BASIC programs to run faster. Also, if you want to develop and sell programs, a compiled program is difficult to copy.

Deluxe Software

As an increasing number of small computers are used by businesses already equipped with mainframes, managers are discovering that personal computers are cost-effective for stand-alone applications. The work can be done instantly, instead of waiting until the company's large computer is available. Small computers are also being used as intelligent terminals: hooked up to a larger system they actually do the computing themselves.

Up to now, the problem has been that small computers store, receive, and transmit data differently than large computers. In other words, a disk prepared on a TRS-80 Model II could not be used in a IBM computer. This incompatibility also created problems with hooking up small computers as terminals.

But Radio Shack has solved the problem, opening up a vast new market for its TRS-80 Model IIs, with the introduction of three new software packages that allow the Model II to communicate with mammoth computers.

ReformaTTer: Converts TRSDOS disks from the Model II to the IBM 3471 format. Also converts IBM disks to TRSDOS format. You can create disks on your Model II, convert them to IBM format, and use them in most IBM computers. The same holds true in reverse ($249).

3270 BiSync Package: Allows the TRS-80 Model II to act as a terminal for any IBM computer equipped with the BSC 3270 communications capability. This includes the IBM 360/370 and the 30 series ($995).

3780 BiSync Package: Allows the Model II to act as a Remote Job Entry (RJE) terminal for equipment with the 3780 communications capability, including almost all of the IBM models and some of the larger Digital Equipment Corporation computers ($995).

Although these software packages are some of the most expensive offered by Radio Shack, they enable companies who already have IBM equipment to connect with the TRS-80 Model II as well as to swap disks. The combined price of the Model II and the software is often considerably less than comparable equipment from the major computer companies.

Best Buy

If you're a small-business man on the verge of buying your first small computer, the Radio Shack TRS-80 Model II is the logical place to start (and keep on going). The Model II system (hardware and software) is highly reliable and easy to use. And it gives a big "bang for the buck." Competing systems with comparable features will cost you 25 to 50 percent more. ■

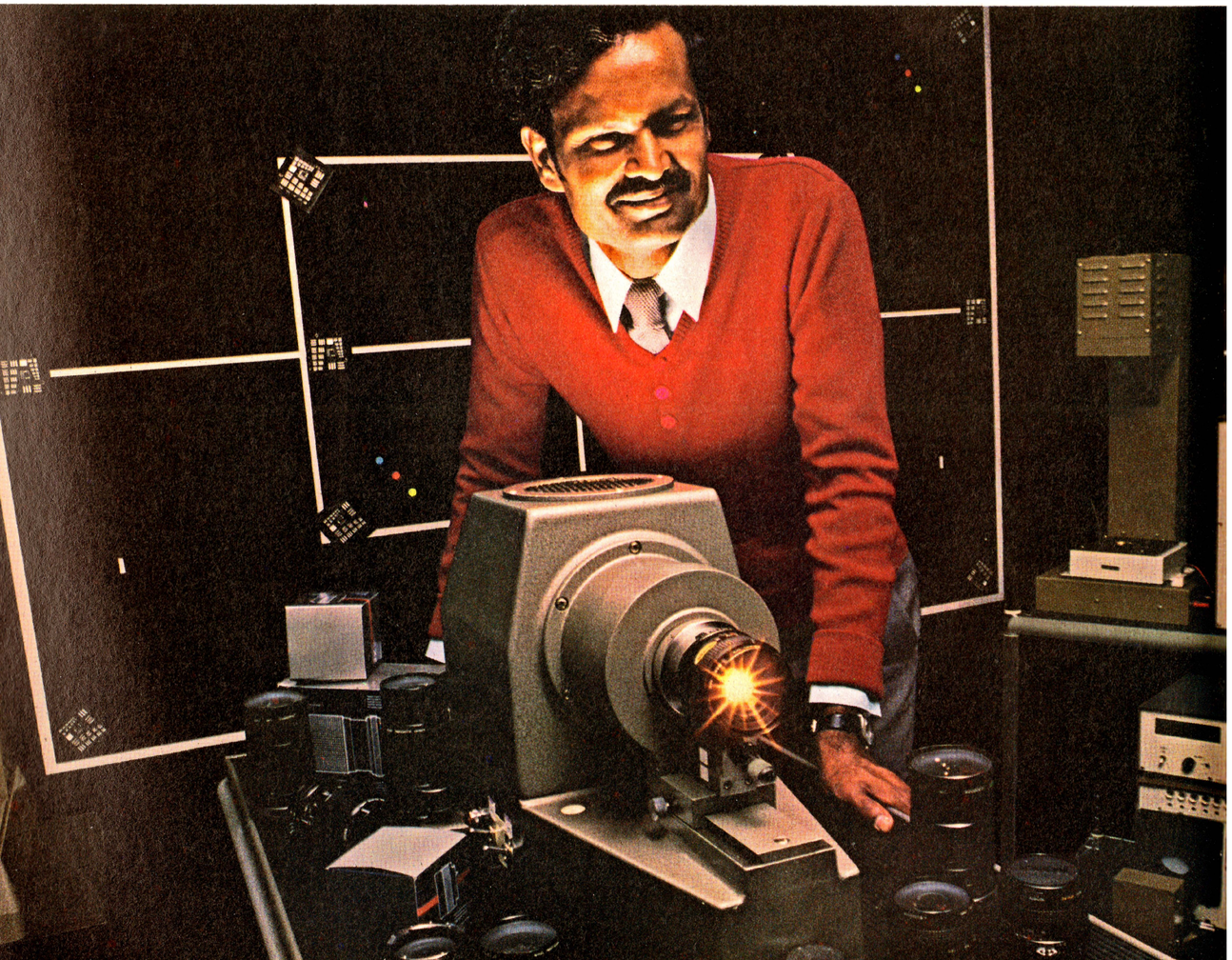
Stan Miastkowski is Managing Editor of Popular Computing.

Reddy Chirra improves his vision with an Apple.

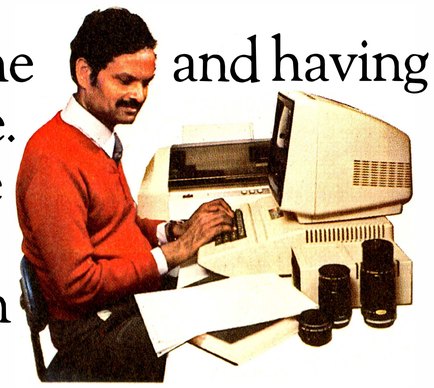
Reddy is an optical engineer who's used to working for big companies and using big mainframes.

But when he started his own consulting business, he soon learned how costly mainframe time can be. So he bought himself a 48K Apple II Personal Computer.

And, like thousands of other engineers and scientists, quickly learned the pleasures of



cutting down on shared time and having his own tamper-proof data base.



His Apple can handle formulas with up to 80 variables and test parameters on 250 different optical glasses.

He can even use BASIC, FORTRAN, Pascal and Assembly languages.

And Apple's HI-RES graphics come in handy for design.

Reddy looked at other microcomputers, but chose Apple for its in-depth documentation, reliability and expandability.

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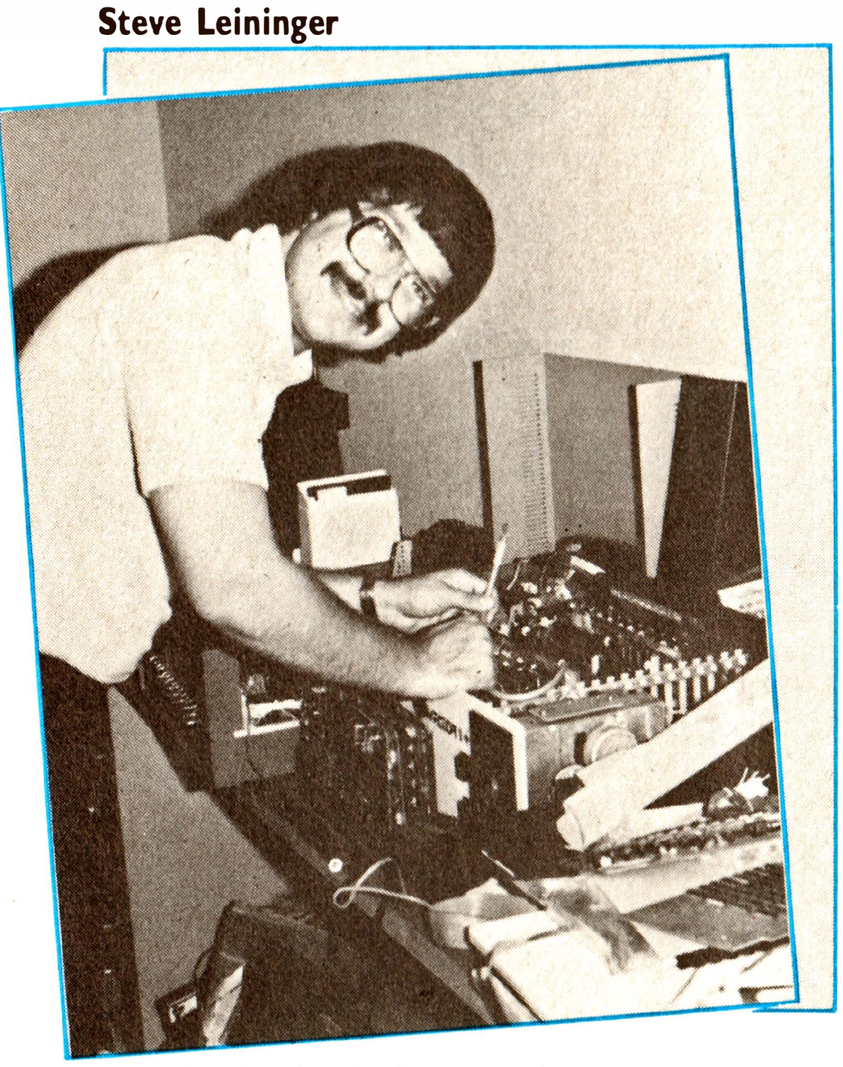
The Men Behind the TRS-80s

by Jonathan Erickson

It had all the ingredients of a top-secret project—which, industrially speaking, it was. There were labs that moved from place to place; a less-than-adequate number of people involved (all sworn to secrecy); nights, weekends, and holidays spent in laboratories poring over schematics and programs; and deadlines that seemed impossible to meet.

Steve Leininger



When Steven Leininger joined Radio Shack in the fall of 1975, the company was still trying to decide whether to sell a microcomputer. No one at Radio Shack seemed to know what kind of computer it should be or even what it should look like, much less what it should do.

Today, six years and countless TRS-80s later, Radio Shack's Model I has found a comfortable niche in computer history and Steve is director of product development for Radio Shack's computer division.

What happened in the interim? Simply, Steve designed and built a personal computer. With, of course, accompanying software. In less than a year. And it has been the leader of the microcomputer pack from the start.

Steve might disavow the comparison, but based on the popularity of the Model I TRS-80, you might argue that he's the "Calvin Klein" of microcomputers. Along the way, he opened the door to the second generation of popular-computer engineers—to people like Dale Chatham, who developed the TRS-80 Color Computer. But that comes later.

In the Beginning

It began with an interest in electronics.

"When I was ten years old and growing up in South Bend, Indiana, my mom bought an electronics kit that didn't have an instruction manual," Steve explains. "I had to figure out everything—what the parts did and how to put them together. That's really when I got into electronics."

By the time he entered high school, his interest in electronics was primarily devoted to audio. During the day he studied electronics, and after school he experimented with practical applications (electric guitars and homemade amplifiers). The decisions that plague most college-bound students—where to go and what to major in—posed no problem. "Where" was hometown Purdue University. "What" was electronics.

Then his focus shifted. Leininger recalls, "I was interested in audio, so all of my preparation was in analog electronics. It wasn't until the last semester of my junior year that I took my first digital course. I was at the Engineering Library and picked up a magazine that had an advertisement for an Intel computer. I looked at that ad for a while and said to myself 'that's going to be a big thing'; then I signed up for some more digital courses. You might say it was love at first byte."

In 1974, with bachelor's and master's degrees in electronic engineering, Steve headed west to the heart of the emerging microcomputer industry—California's Santa Clara Valley. There he divided his time between designing SC/MP (National Semiconductor's early microprocessor) and communicating long distance with Susanne, the girl he left behind. "Six months of calls back to Indiana just about broke me. It was either get married and have her move to the West Coast, or move back to Indiana." She joined him on the West Coast.

Discovered at Last

To earn a little extra cash, Steve began moonlighting at a computer store. One fateful evening a couple of Texans from Radio Shack walked in, and—as luck would have it—Steve was behind the counter.

"Steve's computer-store experience was extremely valuable to him and to us," says Jack Sellers, one of the Texans who walked into the computer store

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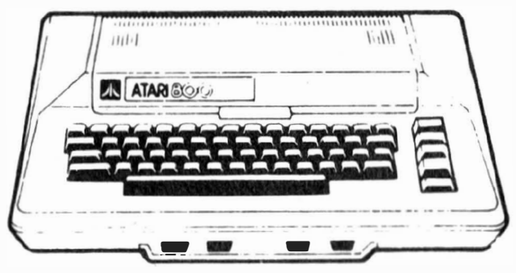

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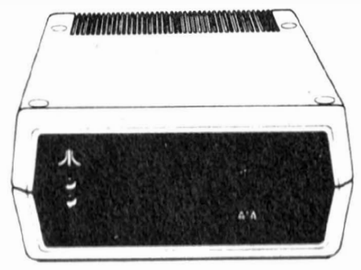

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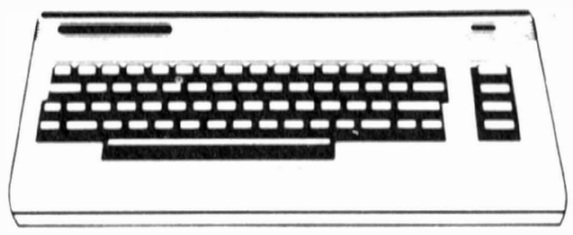

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that night. "He knew what the hobbyist market wanted and yet he was very knowledgeable in the technical areas of computers. It was an exposure that computer people didn't have then."

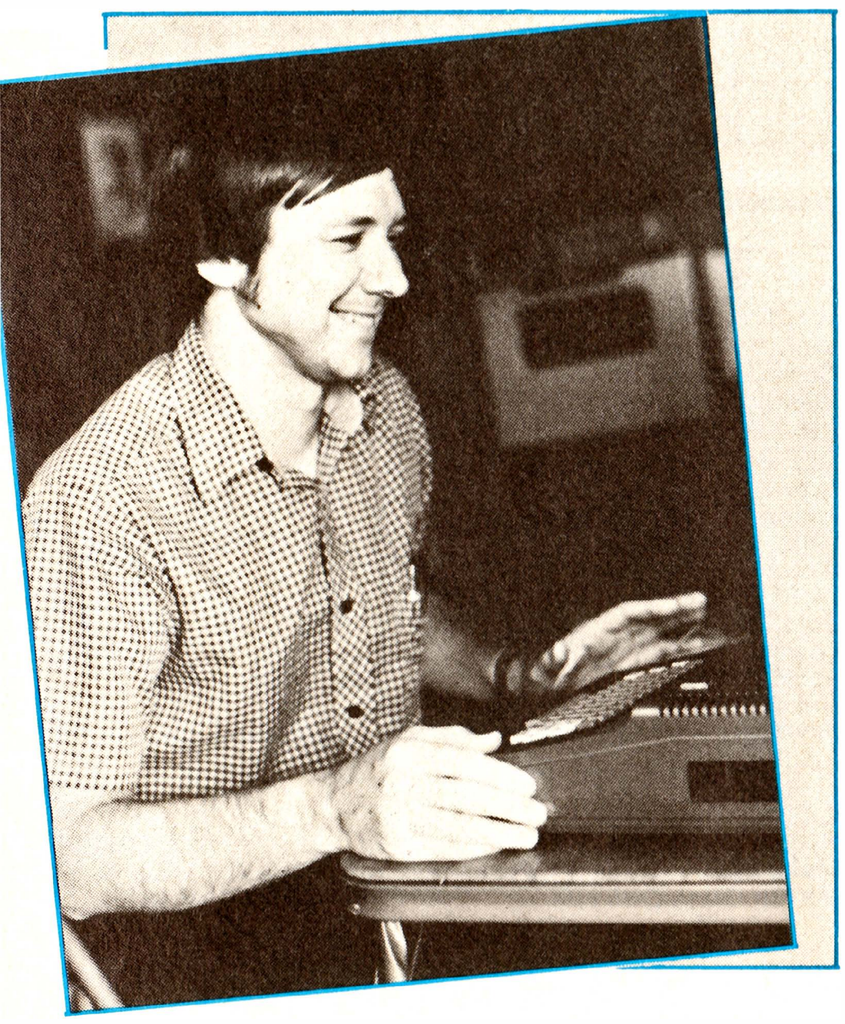
The Leiningers relocated to Texas, Steve as project engineer for Radio Shack.

The Early Stages

Before Steve came on the scene, Radio Shack's early idea was to market a kit that the customer could assemble. The decision to scrap the kit idea and sell a "ready-to-go" computer set the course of personal computing to what it is today.

"That really was an important decision," Leininger notes. "The main reason we decided to forget about the kit was we felt it was too difficult a project. Can you imagine the instructions that would go along with a self-assembled Model II? Some customers were having trouble assembling '100-in-1' kits, let alone something as complex as a computer."

Dale Chatham



But the hardest part was deciding what the computer should be, Leininger remembers. "For instance, there needed to be some way to input information. We chose a standard typewriter keyboard because we felt the customer would be less intimidated. Then we needed some way to output information. We chose a TV-like video because the customer would be familiar with it and it was cheaper than a printer. Next, we needed a way to store information. Cassette tapes would work, they were cheap, and the customer knew what they were. We wanted BASIC built into the ROM and we wanted plenty of RAM for user programs. When we established these criteria, the actual design of the machine seemed relatively simple."

It's rare to find someone who has that almost total grasp on both hardware and software.

Final Push

But the battle wasn't over. In February 1976, Leininger and Sellers (now general manager of Tandy Business Products) decided to go with a Z80 microprocessor and dynamic RAM. The changes would have to be incorporated into the design before April—when they would meet with Charles Tandy, chairman of the board of Tandy Corporation, and try to convince him that the microcomputer could sell.

"At that stage in the development the hardware was never a problem," Steve says. "It was the software that gave us fits. We hired some guy to work on the software, but after a few months he disappeared and we never heard from him again. I was supposed to do the hardware, but now I had to write the software, too."

Days before Tandy's first look at the computer, the BASIC interpreter still wasn't working. They decided not to leave the factory until the computer ran.

"It was after 2 a.m.; both of us were so tired we couldn't see straight because we'd been at the factory about two days," says Sellers. "We knew we were down to the wire and had just about given up. Steve was trying to debug a program and couldn't get the answer. Finally, he took a listing into the other room. I was working on something else and all of a sudden I heard him yell 'Eureka!' He came running into the lab, made the change, and it worked beautifully."

When Tandy came to the factory a couple of days later, Leininger and Sellers had a simple BASIC game for him to try. Tandy apparently liked what he saw and ordered 3000 TRS-80s built with the understanding that if they didn't sell, Radio Shack stores could use them for inventory control.

That was the good news. The bad news was that the first TRS-80 had to be delivered to customers no later than August of the same year—barely three months away. But with Charles Tandy backing them 100 percent, Leininger and Sellers met the deadline—with hours to spare.

"I don't think anyone can really appreciate what Steve did in the early days," says Sellers. "It's rare to find someone who has that almost total grasp of both hardware and software. I don't think there was anyone else that could have done the job under the conditions he worked."

An "Idea Man"

All of that's changed now. Carpeted offices and modern labs have replaced converted closets, and while he still tests a few circuits, Leininger is basically an "idea man" who develops and evaluates new products. Since the Model I, Steve has directed the development of the Model II, the Model III, and the Color Computer, although he didn't work them from start to finish as he did the Model I.

"I think I'm still proudest of the Model I because I did most of that by myself," he says. "None of what we're doing today would ever have taken place if it hadn't been for that computer. And it was great doing a job that nobody else had done before—that no one thought possible. It was a real challenge, one of those once-in-a-

lifetime happenings that I hope I only do once."

A Fellow Engineer

If Steve is a first-generation popular-computer engineer, Dale Chatham is characteristic of the second generation. Since joining Radio Shack a little over two years ago, Dale's major effort has been the TRS-80 Color Computer, a computer that Leininger believes will sell as well as the original Model I.

"Dale was the right person to develop the Color Computer," Steve says. "He's a very good engineer. He's careful and does his planning the first time around."

And, like Leininger, Dale doesn't forget what the customer, the average user, wants. It's easy for him to remember what the computer hobbyist needs: that's how Dale got hooked on personal computing.

"Technically speaking, my background isn't computers," he explains. "When I graduated from UTA (University of Texas-Arlington) in 1975, computers weren't emphasized the way they are today. But I knew a little about computers and was interested in them so I bought a kit and built one in my spare time. Then I bought a Model I. . .now I have a Color Computer too – naturally."

He dropped out of college for a year when he couldn't decide between electrical engineering and genetic engineering and went to work on the assembly line for Texas Instruments. In retrospect, that experience paid off in three ways: (1) he was able to see how design problems influence production; (2) he decided that it would be easier to get a job as an electrical engineer than as a genetic engineer; and (3) assembly-line work wasn't all it was cracked up to be, so he'd better get back to school.

After he earned his degree, Dale returned to Texas Instruments – this time as an engineer designing military products. "The products were very limited," he says. "They definitely weren't consumer-oriented, unless, of course, you like to drop bombs on people."

When Dale answered Radio Shack's ad, he knew he wanted the position.

"The job Steve described was exactly what I had decided I wanted to do," Dale says. "I like working with consumer products. I like being able to go into a store and see something I designed. I feel lucky because every day I'm doing exactly what I want to be doing."

Two designers. Two men who are shaping the future. Steve and Dale are obviously not the sole members of Radio Shack's computer-design group. But they're representative of the "forward-looking" thinkers who have changed Radio Shack's company tag line from "the supermarket of sound" to "the biggest name in little computers." They're the men behind the 8-bit, and they're having a ball. ■

Editor's note: After this article went to press, Steve Leininger resigned from Tandy Corporation to start his own consulting business.

Jonathan Erickson lives in Forth Worth, Texas, and is a technical writer for a major electronics manufacturing and retail firm.

To Lease or Not to Lease?

by Steve Ditlea

The small size and four-figure price tags that characterize today's microcomputer systems make it tempting to stroll into a computer store, write a check, and walk out with a personal computer. However, a four-figure check might strain the budget limitations of the very businesses that could benefit most from installing microcomputers.

As their novelty wears off, microcomputers are being accorded the same financing options available for mainframes and minicomputers. Leasing and bank financing each have their advantages, while many computer stores now offer the added choice of charging data-processing expenses on an ordinary bank or commercial credit card. There are tax ramifications galore to gladden the hearts of accountants and tax lawyers.

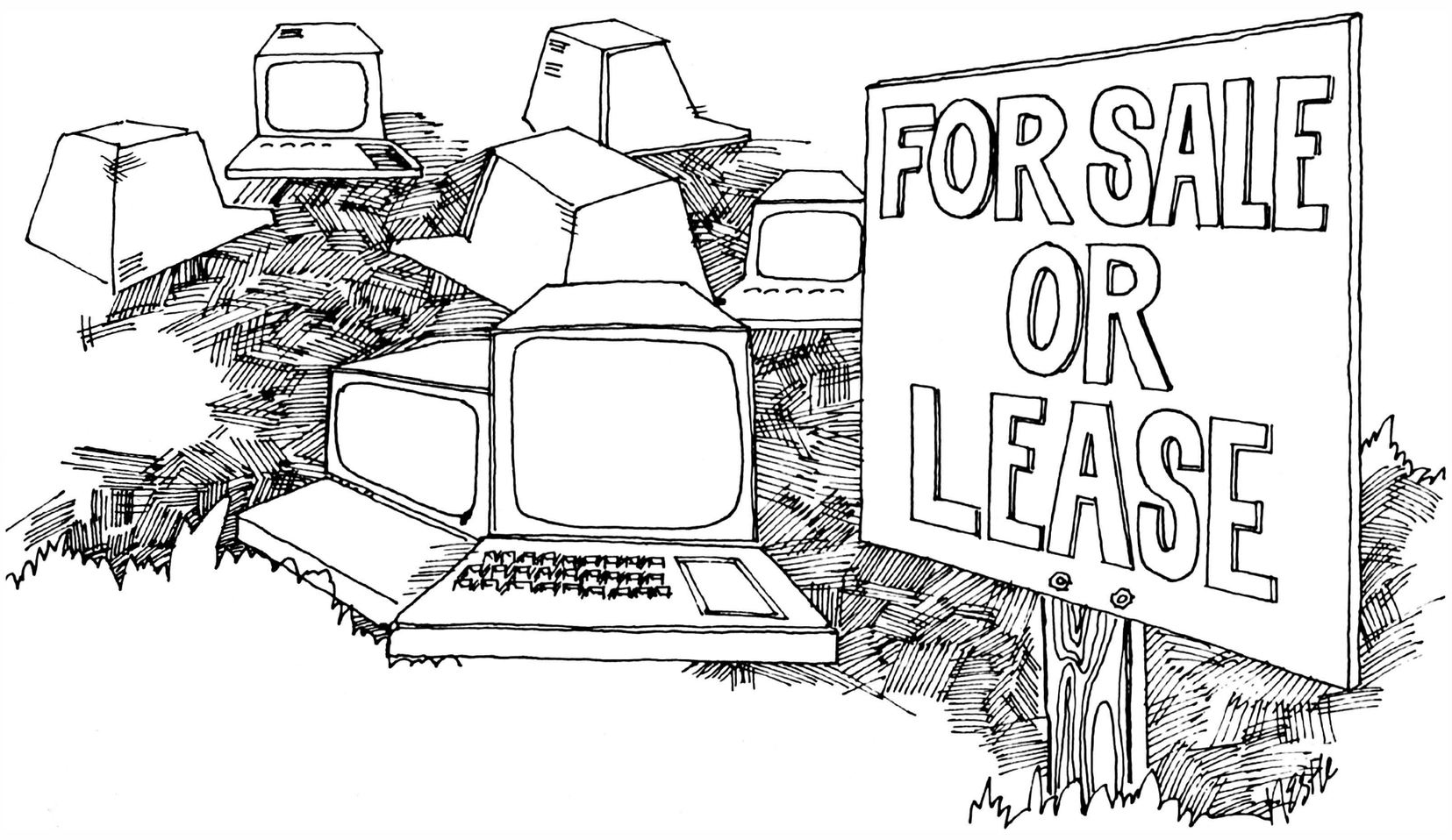
"Close to half our sales involve leasing arrangements," reported Joe Alfieri, a partner in the Computerland of New York shop in midtown Manhattan. "Many of our business customers don't even think in terms of leasing a microcomputer system until our salespeople bring it up. There are two advantages to leasing: you can retain your capital, and you don't have to tie up your bank line of credit. That can be extremely important to a small business."

Steve Ditlea will be a regular Popular Computing *columnist focusing on small computers in business. He is a New York-based free-lance writer whose latest book is* A Simple Guide to Home Computers.

A Booming Industry

Microcomputer leasing has become a booming industry within a matter of months. In January 1980, the Tandy Corporation, long a cash-and-carry business, established Tandy Computer Leasing, offering 39-month leases on any Radio Shack computer over $1500. In November 1980, United States Leasing Corporation, the nation's oldest and largest independent leasing firm, started Apple Leasing as an authorized adjunct of Apple Computer Inc. Retail chains, like Computer Store Inc., have also established in-house microcomputer leasing divisions.

While leasing has long been a mainstay in data processing, the advent of microcomputer leasing has changed the rules. Because of the possibility of quick obsolescence due to some leap in computer technology, microcomputer leases generally last from three to four years instead of the five to seven years common for larger pieces of hardware. Some microcomputer leases allow for upgrading hardware and acquiring software; most require a service contract to assure proper maintenance of the leased equipment. Depending on their interpretation of federal tax regulations, some contracts include an option to purchase the equipment at nominal cost at the end of the lease; other contracts prohibit such title transfer.



Bank Loans Better?

Leasing is chosen for most of the outside financing of microcomputers at the Computer Connection store in downtown San Francisco, but store manager Judie Beaman finds bank loans a more attractive way of financing a small computer. "The loan rate is better," she pointed out, "even though a bank will require a 20 percent down

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payment, while a leasing company will only ask for the first few months' lease charges, about 5 percent or less, as a deposit." The added cost of a lease is seldom referred to as a finance charge; still, it works out to several points above the prime rate. Bank loan rates for microcomputers are usually close to the prime.

Cost is not the only advantage with bank financing. A customer can develop a personal relationship with a banker. The bank officer can get a feel for the customer's business prospects, which helps in determining if a loan is justified. Crystal Konopka, loan officer at a bank, is pleased with the results of financing microcomputers. According to her, "A computer helps people earn more in business. In two years, we've never had one of these loans go bad, which is remarkable." Most banks, however, have yet to recognize the importance of microcomputers for business, making no provision for financing desk-top computers.

Microcomputer systems priced under $5000 can be conveniently financed by charging hardware and software to that American Express/Diners Club/Master Charge/Visa (choose one) credit card in your wallet. Not every card is honored by every microcomputer dealer. But where there is a choice, commercial credit cards have the advantage of higher credit ceilings, while bank credit cards offer greater flexibility in making payments.

When it comes to the tax advantages of leasing versus bank financing versus outright purchase, there is a wide divergence of opinion. The short useful life span attributed to microcomputers may undermine such tax benefits as the investment tax credit on purchases or the full deductibility of lease payments. In the absence of specific tax guidelines for microcomputers, tax write-offs are open to wide interpretation. "It all depends on your taxable situation. Consult your CPA," advised Dale Sisney, president of the Computerland of North Dallas retail store. "Don't expect your computer dealer to give you tax advice. We're just in the business of selling computers." ■

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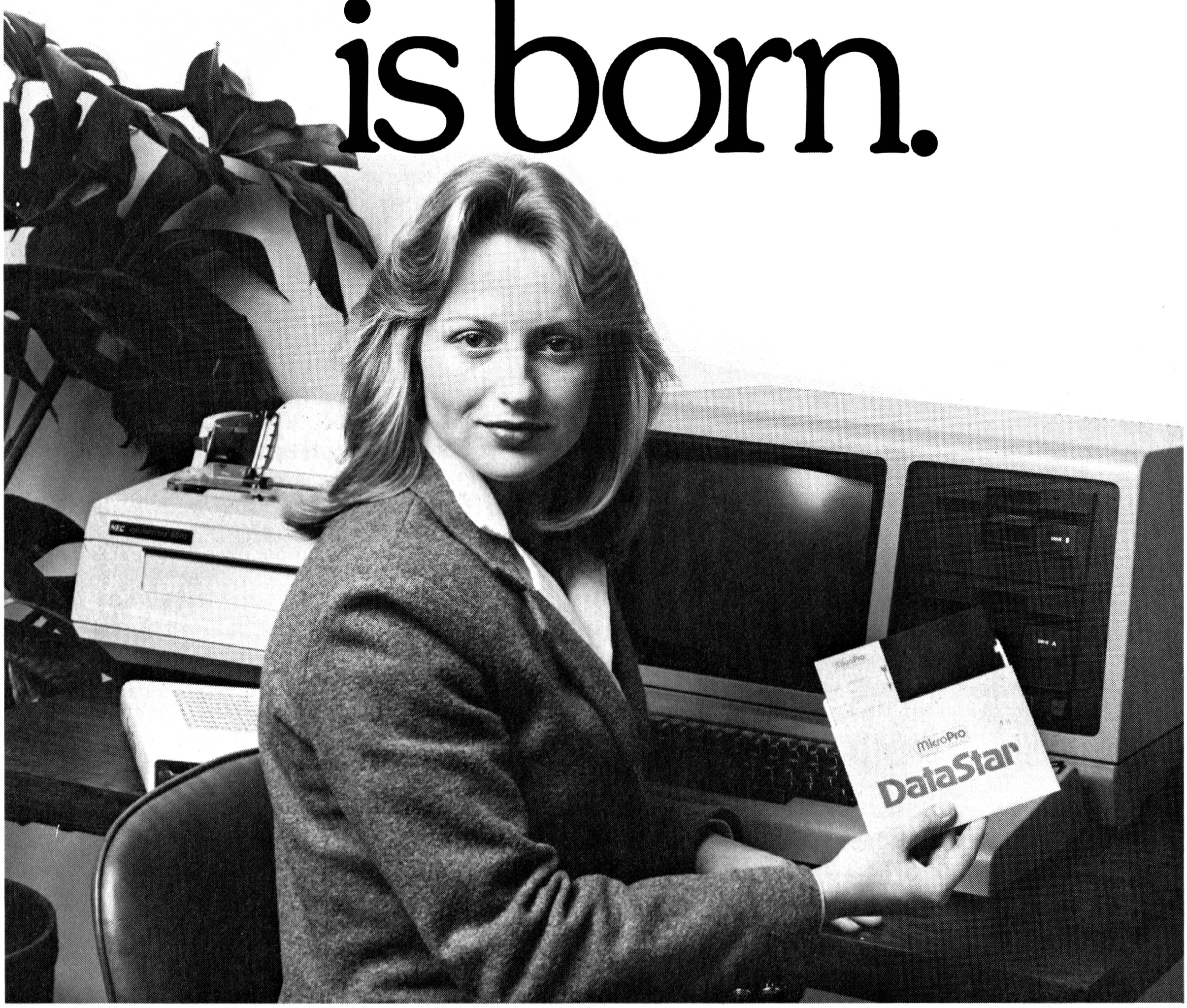

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VisiCalc

An Electronic Worksheet

by Phillip Good

VisiCalc has surged to the front line and is holding its position in a microcomputer market brimming with financial and business software. In fact, even outside the financial community VisiCalc is the software industry's most popular front-runner. Why?

"Immediacy," says VisiCalc user Clark Hurlbert, comptroller for Durametallic Corporation in Kalamazoo, Michigan. "Immediacy, ease of programming, and cost. With VisiCalc, I can do it without help from anyone else."

VisiCalc, published by Personal Software in Sunnyvale, California, is a program that functions as an electronic worksheet, taking the place of a scratch pad, pencil, calculator, and eraser. And if you own an Apple, an Atari, an HP-85, or a TRS-80, VisiCalc is no further away than your nearest computer store or mail-order house.

What Can It Do?

The program lets you enter alphabetic or numeric information in a row-and-column format and then set up relationships between coordinates on the screen; for example, you can make Row 1, Column C the sum of Row 1, Column A and Row 1, Column B. Thereafter, any new number entered into Row 1, Column A will directly and immediately affect the total in Column C. This interdependent relationship can be set up among all of VisiCalc's 254 rows and 63 columns to produce a wall-sized worksheet that speeds all kinds of calculations.

VisiCalc adds, subtracts, multiplies, and divides, and finds partial sums, minimums, maximums, and square roots. It can be applied to forecasts, profit-and-loss statements, rate-of-return calculations, manpower assignments, tax returns, pricing strategies, financial planning, loan amortization, accounts receivable, accounts payable, inventories, bowling scores, league standings, data entry, report generation, chemical calculations, and surveys.

Ten years of monthly entries for up to 254 ledger items can be placed on a single VisiCalc worksheet. You won't, however, be able to see the entire worksheet at one time on the typical 24-line, 40-character TV monitor that comes with a desktop computer. Instead, VisiCalc *scrolls* the worksheet across or up and down the video screen. You can set windows to view the top and bottom of the sheet simultaneously as you scroll. A black-and-white TV screen or monitor is preferable to a color tube because the characters are more legible, and a printer is handy but not essential (the IDS Paper Tiger and the NEC Spinwriter are good choices).

You can enter numbers, labels, or formulas into VisiCalc, or tell the program to duplicate previous entries. The width of columns or the number of decimal places can be altered and VisiCalc will automatically adjust the contents of the worksheet to fit the format. You can save the results on disk and generate hardcopy.

CP/M-based computers like the

Phillip Good is a consultant to major corporations on the use of personal computers.

Three Boys from Boston

The present version of VisiCalc reflects the efforts of 60 or 70 people, but the program originated with three boys from Boston (all MIT graduates). The "dreamer," or "architect," was Dan Bricklin, now an officer of Software Arts, the official author of VisiCalc. Bricklin created the electronic worksheet idea to aid his studies in the Harvard MBA program. Sounding out one of his finance professors on the possibility of marketing the concept, he was told "your idea will never work." The professor did, however, refer him to a former student, Dan Fylstra, who was working on similar popular-computing programs in California.

Fylstra, now the president of Personal Software, provided Bricklin with an Apple and the chance to develop a prototype VisiCalc. Bricklin then teamed up with Bob Franksen, the program's "builder," who converted a quick BASIC implementation into the tight mesh of fast-acting assembly routines that VisiCalc is today.

"It has been a lot of hard work," says Dan Fylstra, adding "It still is."

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Cromemco, the Dynabyte, the North Star, and the Osborne don't have access to VisiCalc . . . yet. Dan Fylstra, president of Personal Software, explains, "There are too many differences among the various types of CP/M-based computers. Our staff spends a lot of time matching VisiCalc to the individual computer. That's what gives VisiCalc its speed."

No Manual Labor

Ease of use, flexibility, and an exceptionally comprehensive manual set VisiCalc apart from other applications-software packages. Hurlbert says that he was able to get VisiCalc up and running in one day after studying the manual. I preferred to spread my lessons over a four-day period, with an hour a day set aside for just that purpose. Whether you complete the lessons in one day or four days is up to you. You can study at your own pace, and you won't need an instructor. The manual includes:

- examples of simple bookkeeping, preparing a household budget, calculating interest on savings, and producing graphs of mathematical functions
- a brief overview of the program
- a series of step-by-step tutorials designed to get you started and to introduce you to each VisiCalc feature
- a command-by-command reference section
- a comprehensive index
- a handy reference card to prop in front of your computer monitor.

There are a couple of things you can't do, however: learn VisiCalc without the manual and skip through the lessons. Each lesson consists of three steps. First, read through a chapter to see what you will be learning. Second, turn on your computer and follow the instructions step by step. (Fortunately, the manual is profusely illustrated. You won't have to guess at the meaning of an instruction and you'll be able to check your work against the illustrations.) Third, reread the chapter and decide how you can apply what you've learned to your own operation. Make a list—you'll come up with half a dozen applications after the first lesson.

Incidentally, as you're mastering the VisiCalc system, you'll find that the manual is highly informative on a variety of topics. On page 8, for example, there is a straightforward explanation of disk initialization which my wife says is the only explanation of disk drives that she hasn't had to reread three times. (Unfortunately, VisiCalc's comprehensive, user-friendly manual is the exception, not the rule. Few software packages are as well documented.)

Always Something New

VisiCalc is constantly being updated and improved. The latest version, 3.3, offers the following features:

- more storage space per floppy disk provided by DOS 3.3, Apple's newest operating system
- formula modification without the need to rekey all information
- a compatible data-storage format which makes VisiCalc's files interchangeable with those of three other Personal Software products: VisiPlot, VisiTrend, and VisiDex.

I used all three features to prepare a series of graphs for my vice-president. I needed the graphs to illustrate the unexpected and accelerated use of our new interactive IBM mainframe computer system. Both an Apple and an IBM terminal are in easy reach of my desk, but the IBM mainframe computer doesn't have the programs required to perform the task simply and I would have had to hire a programmer to use it effectively. Using VisiCalc and VisiPlot on my Apple, I was able to create the graphs I wanted in about fifteen minutes.

More and more employees in large corporations are plugging VisiCalc into their Apples, even though there's an IBM just down the hall. And it's not just the employees, either. Dr. Henry Lee, owner and president of Lee Pharmaceuticals in South El Monte, California, has purchased more than fifty TRS-80 Model I computers. His scientists have them, his salesmen have them, and his secretaries have them. Dr. Lee has two TRS-80s of his own, one at home and one at work. Lee Pharmaceuticals also owns a BASIC/FOUR, Model 730 minicom-

SuperCalc to the Rescue

Help has arrived for the owners of Altos, Altair, Cromemco, Datapoint, Durango, Dynabyte, Heath, Intertec, North Star, Osborne 1, Quay, and the new Xerox 820. SuperCalc, a product of Sorcim Inc., is an electronic worksheet that can be used with any desktop computer with a CP/M operating system.

SuperCalc works with a wider variety of computers than VisiCalc and it offers more features and flexibility:

- *each row or column of the worksheet can have individual format specifications*
- *each cell, row, or column can have separate numeric formats and justifications*
- *row and column labels can be any length*
- *insert, delete, and move commands do not create holes in long labels*
- *current values or formulas can be displayed, printed or stored.*

SuperCalc incorporates all the default options that make VisiCalc so easy to use and has overcome some of the limitations. For example, a single SuperCalc command will give all entries the same format specifications, and the standard border can be suppressed from a printout at the user's option.

Both VisiCalc and SuperCalc are easy to talk to, but unlike VisiCalc, SuperCalc talks back. After you enter the first letter of each command, SuperCalc will spell out and display the command in full. If you misplace your manual, SuperCalc will display the instructions for any and all commands, resulting in faster work. Best of all, SuperCalc lets you create an entire system. Any portion of any worksheet can be integrated into the current worksheet and several worksheets can be tied together or used with subheads.

SuperCalc has a suggested retail price of $295. For more information, contact Sorcim, Inc., 405 Aldo Ave., Santa Clara CA 95050, (408) 727-7634.

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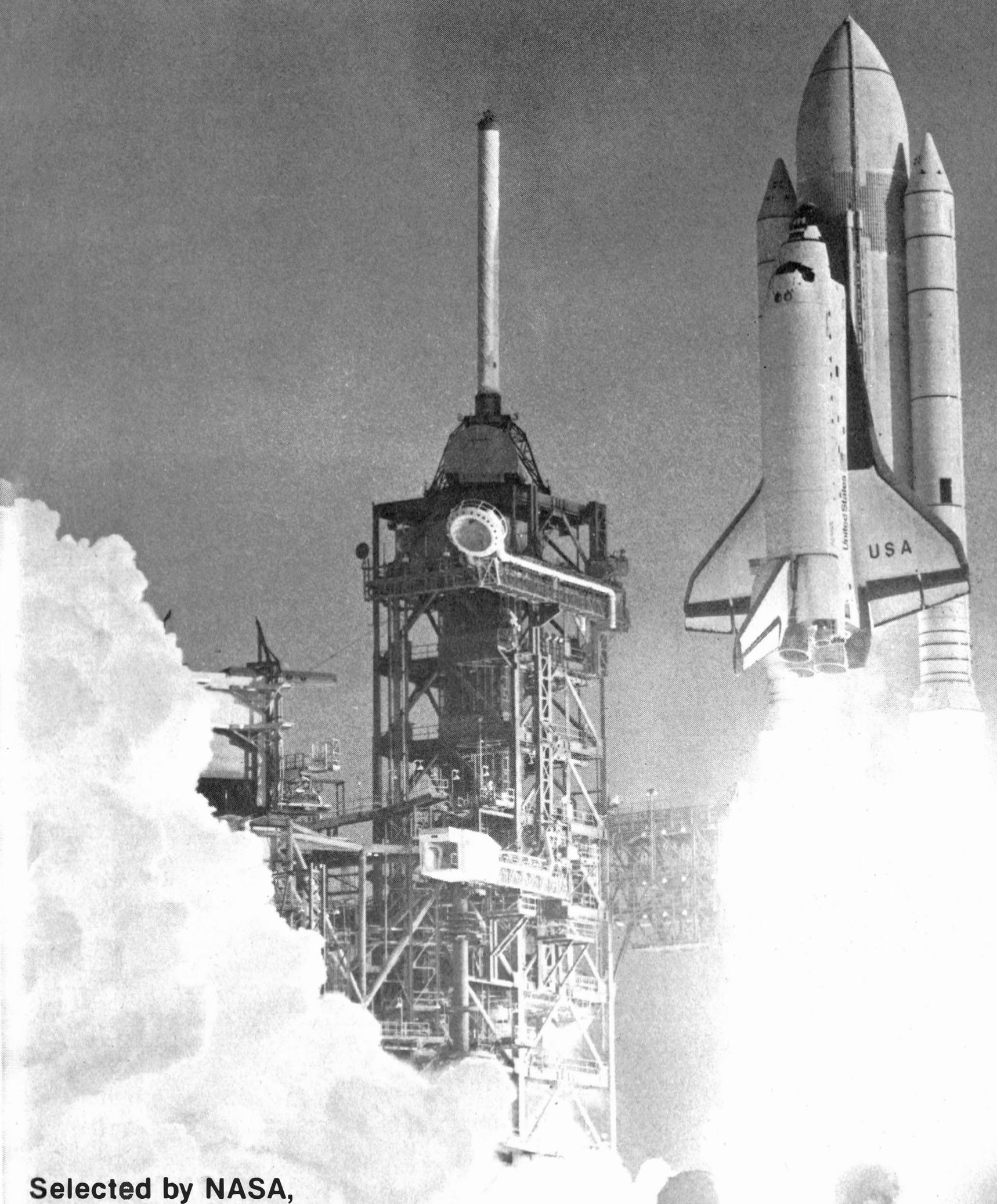

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puter, but a TRS-80 and VisiCalc do the daily profit-and-loss statements.

Steve Stadler, chief financial officer at Genrad, Inc., Concord, Massachusetts, uses VisiCalc and an Apple II to do financial modeling. Genrad's marketing department uses VisiCalc to make projections about new product lines—What will happen if the price of raw materials goes up in a year or two? How will profits be affected? When costs rise, will sales fall? By changing a single number on a VisiCalc worksheet, a department can explore the ramifications for three years of sales.

Arthur Young & Company, one of the nation's largest accounting firms, uses Apples and VisiCalc for financial modeling. So does the Boston office of Horwath & Horwath. In fact, most businesses that own an Apple also own a copy of VisiCalc.

Alternatives

VisiCalc is not a panacea for all software needs, and a number of users try to force it to do something it was not designed to do. It might be wiser to buy a specific application package like a general ledger or an inventory-control program. Order the VisiCalc manual before you buy the software to make sure you can use it. The purchase price of the manual is usually credited toward the cost of the complete system.

Hurlbert says that VisiCalc has repaid its purchase price (at that time, $150) ten times over. But he has also invested more than $1500 in developing custom software for specific tasks that VisiCalc can't perform.

Ellis J. Neiburger, D.D.S., editor of the *Dental Computer Letter*, said he finds VisiCalc's column-and-row format too restrictive. He prefers the flexibility provided by a data-management system like The Modifiable DataBase published by Synergistic Software. And there are programs like Execuplan (about $150 from Vector Graphic dealers) that have almost all the features of VisiCalc plus a built-in reference manual that you can display on your TV monitor.

If you're satisfied with VisiCalc but want to go beyond its abilities, consider High Technology's comprehensive data-base manager, Information Master. The addition of Transit allows use of previously created data files, including VisiCalc ($199.95 for the basic package; an additional $50 with Transit). You might also consider VisiDex, Personal Software's data-base manager, for $199.95, which uses VisiCalc files.

At a Glance

Name: VisiCalc

Use: Business/financial applications such as calculations, forecasts, profit-and-loss statements, manpower assignments, tax returns, pricing, loan amortization, accounts receivable, accounts payable, data entry, report generation, chemical calculations, surveys, and bowling scores

Manufacturer: Personal Software, 1330 Bordeaux Dr., Sunnyvale CA 94086; (408) 745-7841

Price: Approximately $199.95

Requirements: Runs on Apple, Atari, HP-85, and TRS-80 computers

Audience: Business people, accountants, anyone interested in financial planning and record keeping

Conclusion

VisiCalc is one of two computer programs to receive a price/usefulness rating of 100 in *The Book of Apple Computer Software*, a text that provides comprehensive evaluations of almost all programs written for the Apple II computer (see reference).

Each program is rated on six to eight characteristics plus an overall price/usefulness ratio. Typically, scores range from 30 to 95; VisiCalc's lowest rating was 90 for vendor support. Otherwise, VisiCalc received scores of 95 for ease of use, documentation, reliability, and error handling. And for good reason. VisiCalc satisfies not only the basic requirements—it goes many steps beyond.

Reference

The Book of Apple Computer Software. The Book Company, 16720 Hawthorne Blvd., Lawndale, CA 90260, (213) 371-4012. Price: $19.95.

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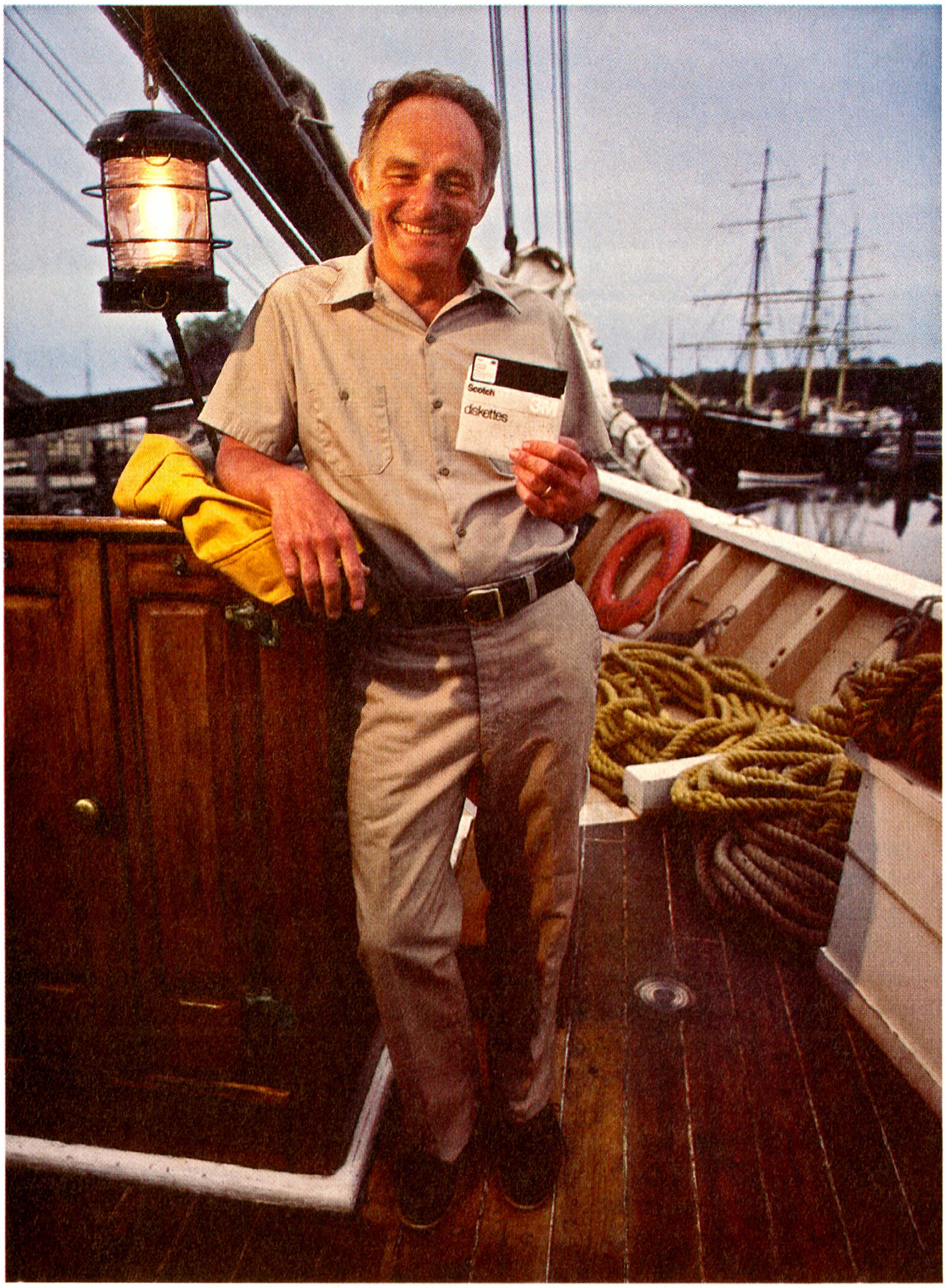

Eben Whitcomb, Owner-Operator, Dirigo Cruise Company, Clinton, CT

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COMPUTER GAMES

Flashing lights and electronic bleeps cast a mesmerizing spell. Battery-powered and microprocessor-controlled, electronic computerized games lead you down a primrose path, gently cajoling and teasing – offering hours of entertainment. That, of course, is when the chemistry works: when the game has a purpose, a well-thought-out method to its madness. A few games become instant hits, though the majority are quickly banished to the lower shelves of rarely opened closets. From Dark Tower to Swat Swat the Mosquito, *Popular Computing* takes a look at some of this year's best and worst.

Dark Tower (Milton Bradley)

It all started with the now-famous Dungeons and Dragons. Over the past few years, fantasy role-playing and adventure games have become increasingly popular. And why not? How else can a mild-mannered editor become a fierce warrior, Sir Boxcar by name, slashing away against the forces of darkness? It sure is more exciting than the morning commute.

The hundreds of fantasy and adventure games now on the market have been produced mainly by very small companies and marketed in a limited manner. It was, obviously, only a matter of time before the major game companies picked up the ball. Milton Bradley has done it with Dark Tower, its major new game for the 1981 Christmas season. Dark Tower is a hybrid—a combination board and computer game.

A big problem with role-playing games like Dungeons and Dragons is the complicated web of interlocking rules, which requires one player to act as "dungeonmaster"—making decisions, calling the moves, interpreting the rules, and throwing the many-sided dice that determine probability. In Dark Tower, the computer (housed in a black plastic tower) takes that role. Combinations of numbers displayed on LEDs (light-emitting diodes) and pictures that light up tell you your status as you move among the four kingdoms on the board.

Milton Bradley has made an admirable contribution to the fantasy role-playing game genre. The object of the game is to retrieve the Ancient Magic Scepter from the Dark Tower. It sounds simple, but remember you must pass through all four kingdoms, gather three keys, warriors, gold, and other things before you're in the clear. The computer in the Dark Tower calls the moves, tallies your gold and warriors, decides who wins the battles, and makes appropriate sounds, from funeral dirges to calls to battle. A number of surprises spring up along the way, and, like many fantasy role-playing games, Dark Tower can go on for hours. The game can be played by one to four people.

Dark Tower is one of the most complicated mass-market games ever sold by a major game company. With its 45-page instruction manual, it's definitely not a game you can take out from under the Christmas tree and start playing immediately. The manual is well written and there is a "learn mode" that teaches you how to play. Dark Tower has many variations and surprises; Milton Bradley is gambling that it won't be one of those games that gets put on the shelf after a couple of days.

Photo by Buckley Associates

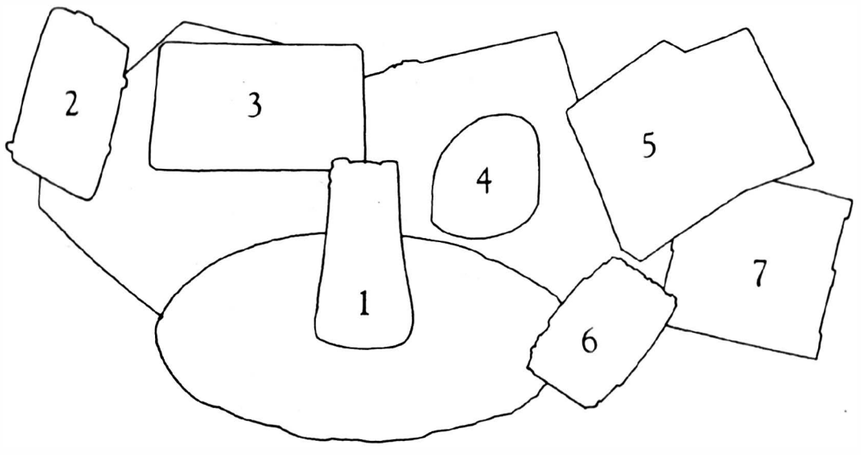
If you've never played a fantasy adventure game, you'll find Dark Tower fascinating and fun. If you have played Dungeons and Dragons, you might find Dark Tower not challenging enough. In any case, Milton Bradley's contribution is sure to produce a wider interest in fantasy games. **SM**

Alien Attack (Coleco)

This game is aptly named. It's designed for a nonhuman sensorimotor system. The game is a simplified, handheld version of Cylon, and the playing features are reasonable and entertaining. With your single ship (one of a series of three per game) you play cat-and-mouse with a horde of attacking aliens in a rectangular pattern of barriers. Both you and the aliens can move in two dimensions and the barriers are impervious to both movement and weapons. You fire rockets; the aliens fire "destructive beams" that look something like star bursts. An interesting feature of the game is that these emissions can persist independently before dissipating. If you're a little slow on the trigger and an alien manages to get off a shot before you fire, the blast can still get you, unless you turn tail and outrun it.

It's fun, but a real problem lies with the fire-and-motion control system. Where many arcade games have separate button-and-toggle arrangements for firing and for motion, Alien Attack does something truly alien. There is a single four-way joystick (for the right hand) that selects direction and a pair of buttons (for the left hand) that either "move" or "fire" in the direction indicated by the toggle. It's confusing enough to describe, but wait till you're up to your gunports in aliens. Invariably you fire when you mean to run and run when you mean to fire. It's infuriating. The controls weren't meant for creatures with only two hemispheres to their brains. I found you can get modest enjoyment out of the game if you make believe you hijacked an alien ship and haven't got the faintest idea in the galaxy how to pilot it.

Alien Attack features two skill levels, differing in speed of play, but that's not really important. After an hour at "Skill 1" all I really wanted to attack was the manufacturer. **PB**



1. Dark Tower; 2. Head to Head Boxing; 3. Super Simon; 4. Scrabble Brand Lexor; 5. Gin Rummy & Black Jack; 6. Galaxian 2; 7. Quiz Whiz Challenger.

Photo by Buckley Associates

Head to Head Electronic Boxing (Coleco)

Head to Head Electronic Boxing is not exactly a "head to head," or cerebral, game. Blip to Blip is a better description of the red duo that slug it out on the game's display screen. They're polite blips at that, shaking gloves before the match while the old Gillette razor company fight song plays to introduce the round.

From opposite corners of the ring, both blips rush out fighting and the action is on! My blip blocks your blip's punch and throws a right. Your blip dances backward, jumps ahead, and delivers a stunning blow. Downed, my blip shows its true grit, rebounding at the count of eight only to be cornered again and thrown to the ropes. The count is final! The referee (also a blip) raises your blip's glove in the air and the fight song plays again.

Head to Head Electronic Boxing can be played against the machine or an opponent on both amateur and pro modes. A joystick controls movement forward, back, left, and right, and two buttons manage blocking and punching. A digital display keeps score and ticks off the knockdown count.

The machine plays a fast and furious game, and, in spite of investing two hours in the attempt, I could not win. As an experiment, I left my blip standing peacefully in the center of the ring and let the game's blip punch at will. My blip was beaten to a pulp.

Head to Head Electronic Boxing does take the blood and gore out of the sport. A brief warning to parents, however. After a few hours of listening to that fight song over and over and over again, you'll be ready for a few rounds yourself! **RW**

Bowlatronic (Coleco)

Bowlatronic bills itself as offering "the total control of real bowling." While the wisdom of making that claim is questionable (control over real bowling being erratic at best), the game is indeed a lot of fun. All the factors of real-life bowling are well integrated into the game. You can release the "ball" from any of six different positions and choose from five separate paths of the ball, which vary in tightness and direction of curves.

Now as all big-time bowlers know, that's not the whole story. The time and speed at which you release the ball also figure heavily in bowling success. But Bowlatronic has that covered, too. A tiny figure of a bowler dashes repeatedly across the top of the screen, in a cycle of varying speeds, to simulate your own approach. By timing your release to the appropriate speed and position in the approach of the little homunculus, you can do very well in the strike department. Failure to time it properly, however, means gutter balls and an intimidating variety of splits.

The game (for one to four players) automatically keeps score, plays fanfares for strikes and spares, and comes equipped with a "hint" capability—press the hint button and the screen displays the ideal ball path for any arrangement of pins; it's especially helpful on those sticky splits.

If the measure of the quality of a simulation game is its likeness to the real thing, then Bowlatronic deserves an A. I get the same average on Bowlatronic as I do in real bowling. Don't ask. Let's just say it involves less than total control. **PB**

Simon (Milton Bradley)

Simon says the blue, then the red, the blue again, two yellows, and a green! It's a high-speed chase to catch this electronic toy's flashing lights and sounds and repeat them in increasingly long sequences.

Simon looks like a flying saucer with four colored lenses that light up in random sequences. Sounds reminiscent of *Close Encounters of the Third Kind* bleep along with the flashing lights. There are four variations on the basic "repeat after me" game and four skill levels for play with one or more contestants.

Although I first thought Simon a rather moronic diversion, I quickly became infatuated with it, playing until the wee hours of the morning when my neighbors threatened revolt at the electronic bleeps emanating from my apartment (Simon emits a wonderful raspberry when an out-of-sequence color is played). What had seemed mindless actually began to improve my memory, developed my motor skills, and, if the real story must be told, kept me entertained for days. **RW**

Super Simon (Milton Bradley)

Super Simon is a souped-up edition of Simon. The game features a double keyboard of color lenses (for those contests in which players oppose one another) and various auxiliary controls; these govern skill level and speed of play, indicate who won, and play back memorable game sequences.

Five different games are available, all challenges to your memory or reflexes, or both. In the most elementary game, the machine generates an ever-lengthening series of signals, consisting of flashing color keys accompanied by musical tones. Each player is required to repeat the series by pressing the appropriate keys. After each successful reproduction, Super Simon adds a new signal. Rather like "I Load My Ship With. . . ." In a variation on that theme, play does not proceed in strict rotation; rather, Super Simon selects which player is "it" and he or she must respond. Another game features a trial by elimination in which each player is assigned a particular color and is responsible for pressing that key in the proper imitative sequence.

The other two games are more reflex-oriented. Players must respond to each individual signal while, or immediately after, it is generated. All the games can be played by one to four (or more, they say) players, but the latter two games are specifically geared to "head-to-head" competition. No helmets required.

You can select among three speeds of play (simple, normal, or super), and there are four skill levels, corresponding to the maximum number of tones Super Simon will include in a sequence. **PB**

Scrabble Brand Lexor (Selchow and Righter)

Scrabble has always been a top-notch board game for punching up your verbal skills and bringing words to the tip of your tongue. Scrabble Brand Lexor does it too, but it lacks the complexity and player interaction that the board game provides.

In the flash mode (played by two or more competitors), seven letters appear on the game's display screen and each player forms as many words as possible in an allotted time. As in Scrabble, each letter has a value, and the Lexor scorekeeper totals your score. In the solo mode (played by one person), Lexor displays 7 letters in 14 different turns and you try to find the highest-scoring word.

Lexor can also be used as a scorekeeper for the regular Scrabble board game. Entering letters, bonuses, and player numbers is so time consuming, however, that you could more easily use your calculator or a pencil.

What is attractive about Lexor is the way children take to it. While I love the sensation of cool, smooth Scrabble tiles under my fingertips, kids can't keep their hands off Lexor's electronic buttons. **RW**

Reader's Digest Q & A (Selchow and Righter)

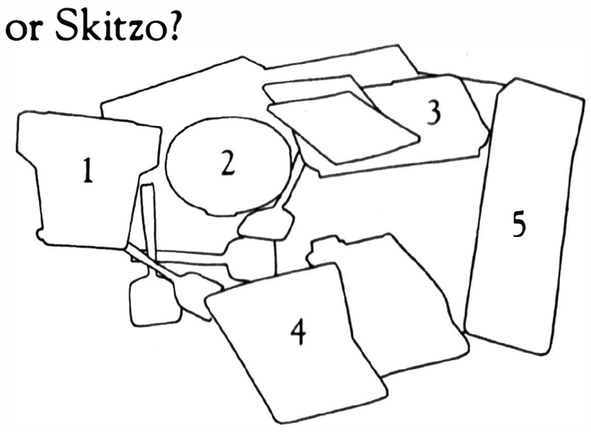
With typical *Reader's Digest* optimism, this electronic multiple-choice game touts itself as "a passageway to a new and happier life." In fact, it's a way to learn a few new words and brush up on some history.

Q & A includes a keyboard, a Word Power booklet containing 94 vocabulary quizzes with 20 questions each, and a Brain Power booklet containing 63 sets of questions on subjects ranging from astronomy to movie stars. You simply punch in the code for the quiz of your choice, then punch in the letter of one of the four possible answers to each question.

The small red display screen tells you whether you're right or wrong and flashes your score. As the booklets are completely separate from the keyboard unit, I couldn't help wondering why someone didn't just print the answers in the back of the book.

When two people play Q & A, the first player answers all 20 questions and has his score tallied by the computer, which keeps track of that score—plus a few special features called bonuses and duels—as the second person answers the same 20 questions.

Some of the questions present a dilemma familiar to survivors of high school multiple-choice tests: none of the answers seems quite right. After you've played each quiz once, moreover, the game offers no further challenge. But one Brain Power question is almost worth the price of the game. It asks which of the following is not a Marx brother: Harpo, Zeppo, Chico, or Skitzo? **JH**



1. Alien Attack; 2. Swat Swat the Mosquito; 3. Reader's Digest Q & A; 4. MAC MiniComputer; 5. Bowlatronic.

MAC Mini Computer (Entex)

MAC is a superlative Christmas investment—it's packed with hours of exploration and discovery for children and adults alike.

MAC is an actual computer featuring a 16-LED matrix, 8-digit fluorescent display, piano and organ music, and a compact keyboard. It's all packaged in a bright red plastic casing that's not only sturdy but attracts kids like a magnet.

The "mini" computer can be used in four different modes. The music mode plays both piano and organ tones and the musical keyboard includes flats and sharps. Tunes can be recorded and played back, and a cheerful version of "Yankee Doodle Dandy" is preprogrammed into the computer as an example of its musical capabilities. The MAC manual contains complete instructions for programming songs, and it has a basic introduction to musical scales, notes, pauses, and more. The computer can also be programmed to function as a metronome for aspiring musicians.

The calculator mode turns MAC into a full-fledged calculator with four functions and memory. It's the MAC manual, however, that makes the machine more than an electronic abacus. It provides an easy-to-read chapter on negative numbers, decimals, and exponential calculations, and also includes sample math problems and games.

MAC's game mode is a fifty-fifty split between pure entertainment and education. Tic-Tac-Toe, Concentration, and several other games are preprogrammed into the computer for use on program cards that slide in front of the display matrix. My kids spent hours with the World Time game, which can determine the time in any part of the world by plugging a simple formula into the machine.

The most dynamic aspect of the "mini" computer is the programming mode. After a clear and concise explanation of computers in general, number systems, data bases, memory, peripherals, and like topics, the MAC manual leads users into an understandable section on MAC itself—chips, electronics, and all.

After a brief example, children are encouraged to write their own programs for light and music shows. Mine spent hours quietly discussing programming steps, figuring out what went wrong in some programs, and cheering with delight when one ran according to plan. I also found adults who are usually intimidated by larger computers becoming comfortable and intrigued with MAC. **RW**

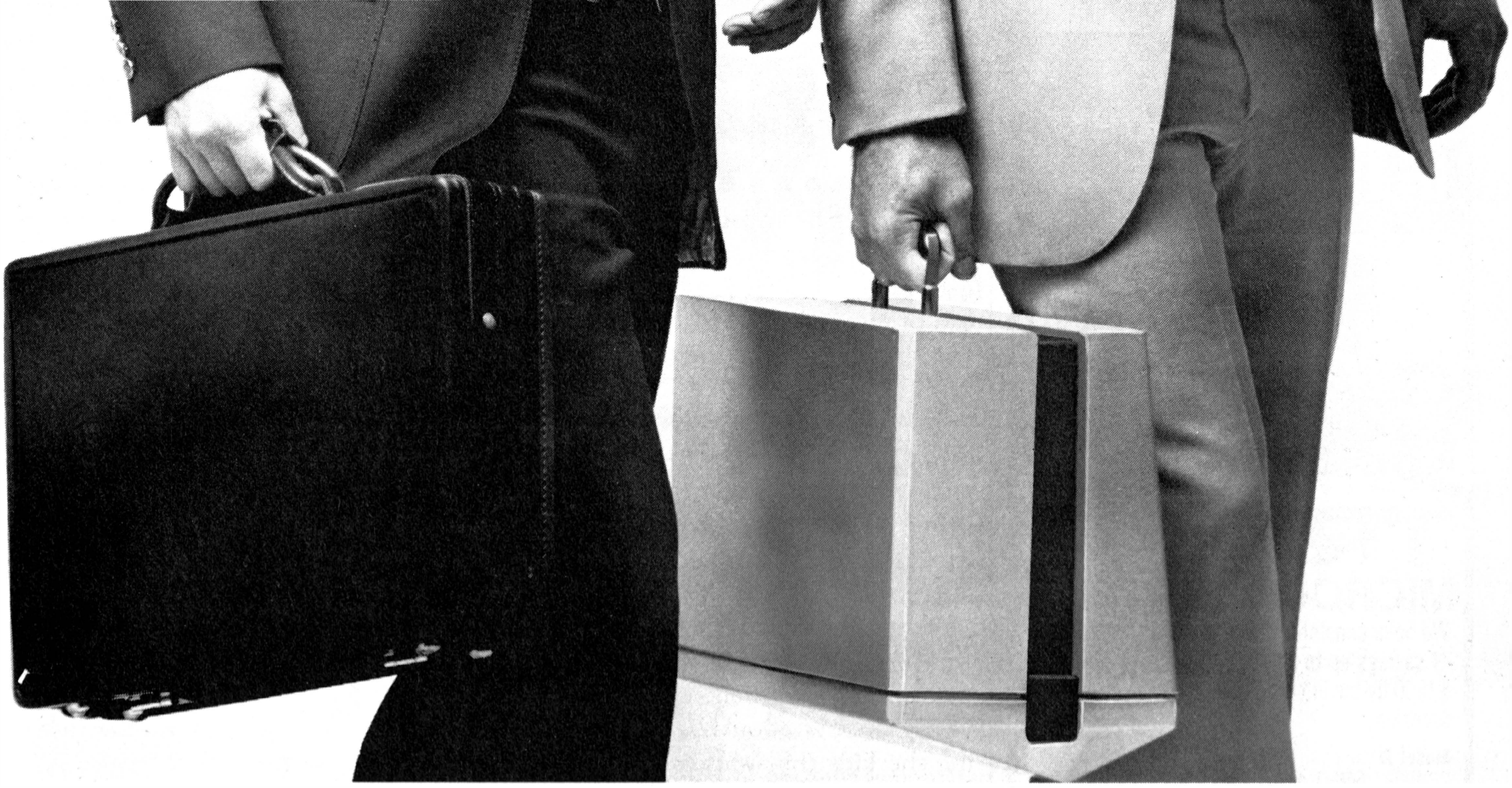
Quiz Whiz Challenger (Coleco)

Coleco currently offers more than two dozen "Quiz Whiz" packages: small one-player electronic games that test your knowledge on everything from math to sports to trivia. The Quiz Whiz product line has become one of the staples of the toy industry over the past few years, and Coleco decided to introduce Quiz Whiz Challenger to broaden the game's horizons.

Quiz Whiz Challenger takes any of the Quiz Whiz cartridges. Since the answers are contained in an electronic ROM (read-only memory), all you have to do is plug the cartridge into the Challenger and presto—you have a competitive game for up to four players.

There are basically two ways to play: either you can see, at the end of the game, who got the most correct answers, or you can play so that only the first person to answer correctly gets the points.

The microprocessor in the Challenger selects the questions, on a random basis, from a thick book. They're then read aloud. Like many electronic games, flashing lights and sound effects add a high-tech ambience to the action. There are less productive ways to pass a rainy afternoon. **SM**



The guy on the left doesn't stand a chance.

The guy on the left has two file folders, a news magazine, and a sandwich.

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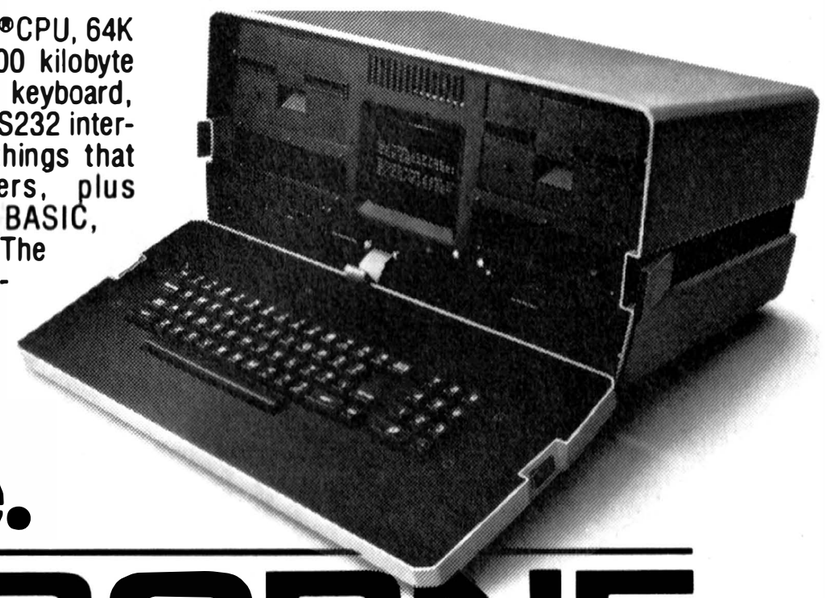

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Popular Reviews

Swat Swat the Mosquito (Coleco)

This game's annoyingly realistic buzzing sound will send you scurrying for a can of insecticide. I highly recommend you spray it. Maybe the bug killer will stop the game cold.

Absolutely the only action in Swat Swat the Mosquito comes from players using red plastic swatters to whack the living daylights out of a small round game board. The lighted mosquito that appears at random on the board moves so slowly, and lands in the designated whacking places so infrequently, that the game poses a challenge only to very young children. You'd be better off giving the kids the swatters and sending them after real mosquitoes.

The game does make an amusing sound when the mosquito dies. No score is displayed, however, making it difficult for players to know who's closest to the goal of squashing five bugs. **JH**

Galaxian2 (Entex)

Galaxian2 is a scaled-down model of the similarly named arcade game, featuring a double rank of attacking alien vessels in blue, a series of three defending ships (that's you) in red, a green starfield, rockets and bombs, and sound effects. Play is much like that in the arcade game. Your ship is free to move back and forth along the bottom of the screen (an LED display, in this miniversion) and to fire rockets at will. Noncombatant aliens shuffle back and forth across the top of the screen, while every now and then one of their number detaches itself from formation and speeds toward you, raining bombs all the way. If you can't take the little devil out by the time it reaches your level, it emerges again at the top of the screen for another pass. You score more points for downing one of these aggressive types than for picking off its more quiescent comrades.

The game is entertaining for a while, but it doesn't wear well. Unlike the arcade version, the attackers move slowly; their bombs, when released, fall vertically instead of following a trajectory, and consequently they're easy to dodge. Your rockets always destroy your opponents' bombs. You can rack up a pretty impressive score just by waiting in the corner and maintaining a steady rate of fire—like shooting Venusians in a barrel. The defending ship is essentially safe from all but chance collisions with swooping aliens. You can make the game more interesting by promising yourself not to shoot sitting ducks—only the high-score, gung-ho aggressors.

The two-player version of the game affords some additional interest. By setting the appropriate option switch, a second player can take over the role of the aliens and direct their single-ship bombing runs with more craftiness. In either version, play continues until all three defending ships have been destroyed or until the defending player gets a cramped finger from running up monstrous scores. **PB**

Gin Rummy & Black Jack (Entex)

"8-Adult," huh? Despite what the box cover claims, I'd say this game is geared toward cardsharks who speak fluent Las Vegas jargon. Not a frequent card player, I found the instructions confusing. When I finally got going, I beat the computer some of the time and it beat me most of time.

However, in my quest to remain objective, I handed the game over to a friend—an ex-Navy man, who "spent many hours in submarines playing cards."

A zillion beeps and 100 games later, his opinion was that if you understand the "guts" of card playing, as in knowing the odds of winning with a given hand, you can conquer the computer. His final words of wisdom: "You *can* beat this thing, but don't think you can beat Vegas!" **CLM**■

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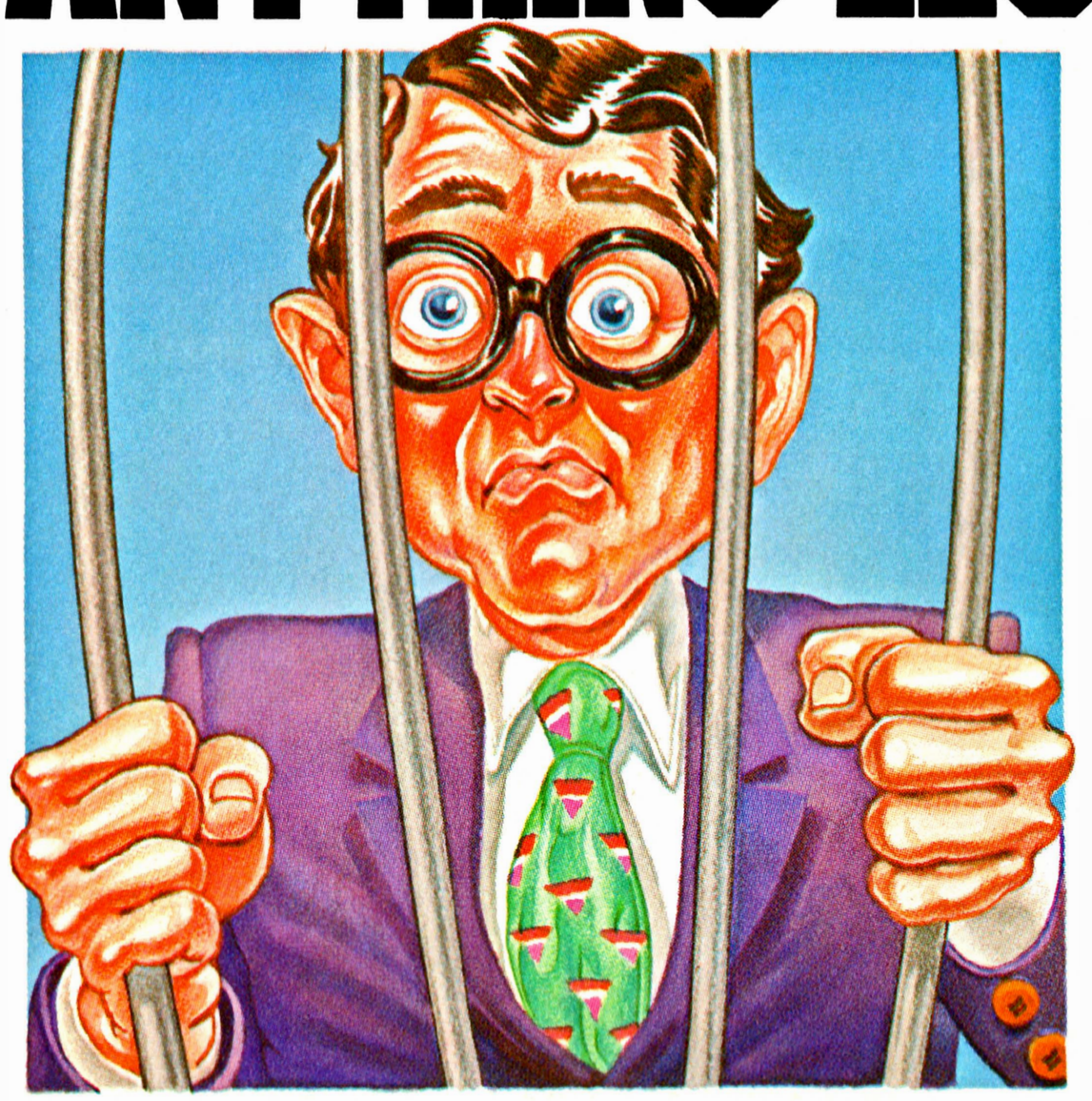

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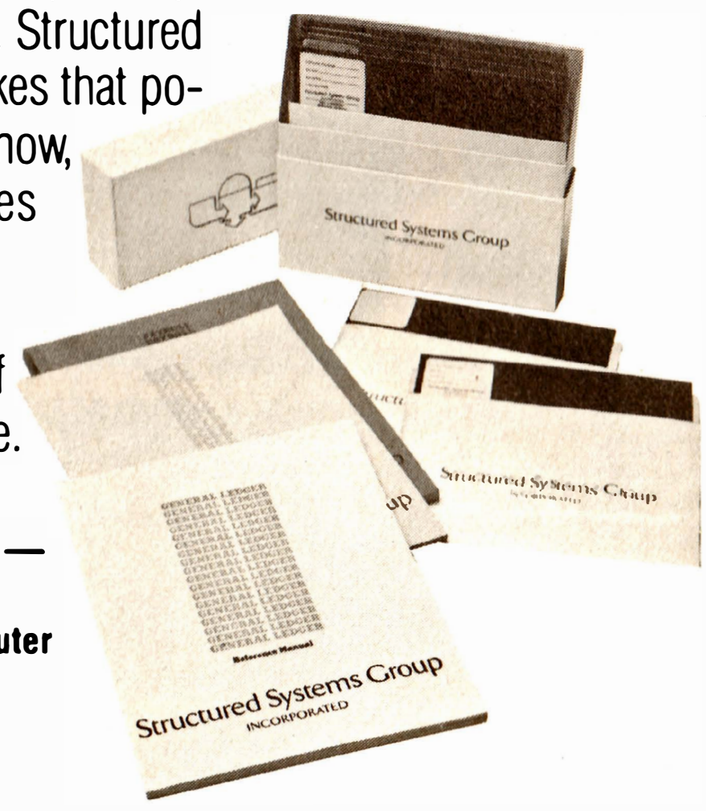

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REVOLUTION IN TOYLAND

The Development of Electronic Games

by Heidi Copeland

Electronic technology has created a once-in-a-lifetime revolution in the toy industry. But the beeping electronic games that seemed to appear overnight on toy-store shelves actually followed a gradual upheaval that shook the very roots of toyland economics. Talks with toy-company executives and designers provide some clues to the nationwide fascination with the intelligent toy.

Economics in Toyland

George Ditomassi, marketing director for Milton Bradley Co., can afford to relax. While many in the frantic toy business are brooding over hard times, Ditomassi exudes confidence as he leisurely puffs on his pipe at the company's Springfield, Massachusetts headquarters. Not only is Milton Bradley's electronic Simon collection the current trade bestseller, but Ditomassi also believes this year's Christmas toy shoppers will retain their enthusiasm for heavily promoted brand-name items.

Ditomassi and other toy experts compare the advent of computer chips with the arrival of plastics. Plastics gave toys new shapes; silicon chips gave them brains. But Ditomassi recalls the skepticism with which the toy industry greeted electronics. Almost everything about the newfangled electronic playthings, he says, went against the grain of standard toy manufacturing.

First, computer games required months of research and development, lengthening production time to an almost-unheard-of two years. The steel molds required to create the toys' plastic parts cost between $30,000 and $250,000. And the fiercely independent toy industry rebelled against the idea of having to purchase the brains for the new electronic toys from outside companies like Texas Instruments. All told, these factors drove the cost of computer toys as much as ten times higher than the cost of most board games. Manufacturers' increased costs, of course, translated into a big jump in consumer prices.

Accustomed to selling traditional toys for an average of $3, Milton Bradley executives were unnerved by the $20 price tag the company had to affix to its first line of electronic toys. No one in the company, or in the toy industry at large, was confident that consumers would pay.

In some cases the fear was justified. Milton Bradley, for example, spent a small fortune researching and developing a voice-synthesizer toy called Milton. The toy and its $70 price tag bombed almost immediately upon hitting the market. Unwilling to abandon the chip, Milton Bradley recycled it into Say It Again, Sam, which the company presented at a recent toy fair. But Sam was as poorly received as his predecessor, Milton, and the toy was dumped from Milton Bradley's line.

"Technologically, the speech chip was brilliant," says Ditomassi. "But technology alone doesn't sell toys." Ditomassi believes one underlying problem in promoting computer-based speaking toys was that consumers never realized how the new talking toys differed from speaking-tape toys like the Chatty Cathy doll that had been awakening them on Christmas mornings for years.

Shaky Beginnings

On the other side of Massachusetts, officials of Milton Bradley's arch rival, Parker Brothers, developed a similar case of the jitters when they began considering computer toys in early 1975. Having built its success on board games like Monopoly, the Salem-based company rejected prototypes of a number of microprocessor games. Then a savvy design firm called MicroCosmos (see accompanying story) presented Parker Brothers with a toy that combined electronics with a board format. The resulting submarine game, dubbed Code Name: Sector, was introduced by Parkers Brothers during the 1977 holiday season.

That same Christmas, Milton Bradley's first intelligent toys, Comp IV and Electronic Battleship, rang up sales to the tune of $8 million. And the maker of Barbie, Mattel Inc., grabbed almost half the total electronic-toy business with its Electronic Football.

By 1978, the number of electronic toys on the market had swelled to about 40. Milton Bradley scored with Simon, generally considered the industry beauty, and Parker Brothers emerged with Merlin, the brains. Simon, a flashing-light game based on Follow the Leader, is round, colorful, and friendly. Merlin, which resembles a space-age telephone receiver, uses its wizardry to play five different games. The two consistently outsell all other electronic toys—and consistency is rare in an industry where this season's fad often becomes next season's dust collector.

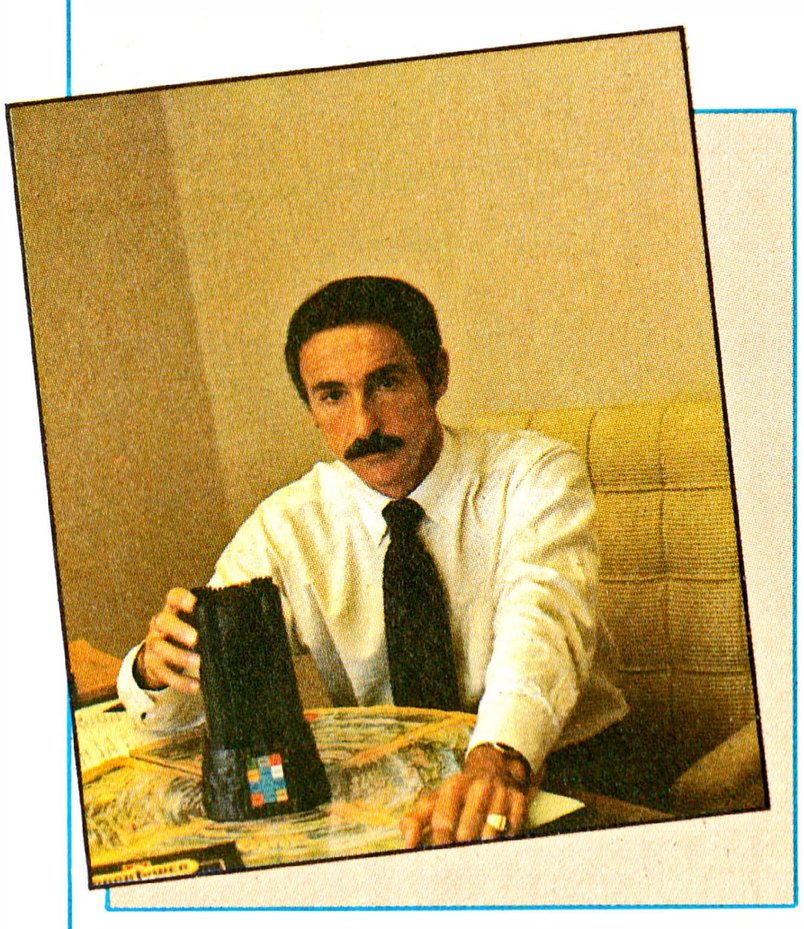
For several manufacturers, the tremors of the electronic-toy revolution foreshadowed a financial and marketing earthquake. At the dawn of the microprocessor age, only a few companies could afford to develop, manufacture, and market electronic toys. But as the price of silicon chips dropped, more and more toy makers became convinced they had to enter the electronics market to stay alive. The result was a glut that flooded shelves last Christmas with almost 400 electronic toys. Retailers and manufacturers bore the brunt of inventory liquidation, and a number of smaller companies folded.

The electronics revolution also brought changes in previously well-defined markets. Game manufacturers, accustomed to catering to 7- to 15-year-olds, suddenly found adults from 18 to

Synthetics gave toys new shapes; silicon chips gave them brains.

The Magic of MicroCosmos

Tucked away in the scholarly atmosphere of Cambridge, Massachusetts, a space-age Santa's workshop called MicroCosmos formulates future



This year's hopeful, Dark Tower, is demonstrated by Milton Bradley Marketing Director, George Ditomassi.

fun for the rest of the country. It's a short walk from Harvard University to the rambling house that serves as the company's headquarters, but MicroCosmos represents a big career change for its two Harvard-educated owners, Holly Thomis Doyle and her husband, Bob.

The pair, both of whom hold Ph Ds in astrophysics, turned the toy industry on its ear in 1978 with Merlin, now the best-selling electronic toy (grouped together, the Simon toys sell more, but Merlin is the largest single seller). Since then, MicroCosmos has delighted toy fans with five more computerized playthings.

Stints with the NASA Skylab project and a film equipment company convinced the Doyles they could balance the two-career juggling act only by starting their own business. In collaboration with Holly's brother, computer analyst Wendl Thomis, the Doyles created MicroCosmos in a Cambridge apartment in 1974. They developed prototypes for four electronic games, soliciting ideas from their two sons and crowds of inquisitive neighborhood children.

Game ideas flowed freely, but the Doyles' toughest task was creating a microcomputer from scratch. The couple and Thomis spent the first year engineering microprocessor circuitry to run the games.

As the prototypes neared completion, MicroCosmos bombarded the marketing departments of large toy companies with letters introducing its games and predicting a $100 million industry in electronic toys. The predictions turned out to be conservative. Last year electronic game sales soared to almost $500 million.

Despite MicroCosmos' futuristic visions, Parker Brothers, the company that now puts the Doyles' ideas into plastic, was not easily wooed. In 1975, the company used the word "ridiculous" to describe Holly's idea for an electronic tic-tac-toe game. "Who would pay $15 for a game you can play with paper and pencil for nothing?" one executive asked.

The MicroCosmos crew returned to the drawing board, emerging with a submarine game that linked electronics with the board format so familiar in Parker Brothers' games like Monopoly. The company accepted the game, titled it Code Name: Sector, and presented it two years later for Christmas of 1977.

Sector's success emboldened Parker Brothers to accept and introduce Merlin, a hand-held electronic toy that plays five games, including the previously maligned tic-tac-toe. Since 1978, the Doyles have created such popular games as Wildfire, Stop Thief, P.E.G.S., and this year's newcomer, Reflex.

But many of the Doyles' favorite ideas have been rejected as too complicated for the general public. Merlin, for instance, was the "result of restraints instead of wild ideas," Holly says. Parker Brothers agreed to go with a hand-held toy, but it wanted more than one game to justify the price tag. The company also insisted the game have no more than eleven buttons.

"Inventing is like painting a picture," Holly explains. "You start with certain tools— a piece of canvas and a set number of colors on a palette—and you work within those restrictions." MicroCosmos' offices, overflowing with terminals and futuristic gadgets, provide evidence that the pure act of inventing a game can sometimes be more fun than playing one. The Doyles' 16-year-old son, Rob, recently got into the act, joining the staff and presenting his first game idea to Parker Brothers.

What does the future hold for inventors? The ultimate game, according to Holly, is a room full of robots in which players create their own games. For Bob Doyle, on the other hand, the best game already exists in

Bob Doyle and Holly Thomis Doyle try out some toys at MicroCosmos, their independent toy-design firm that put electronics at the top of Parker Brothers' game line.

the real world. Its goal is "trying to arrange people, resources, and ideas to bring new things into existence." In that game, MicroCosmos is a championship player.■

40 raiding toy-store shelves. And the raids didn't come only at Christmas, when 60 percent of each year's toy sales had traditionally been chalked up. With electronic games selling to different types of customers and at different times of the year than companies had anticipated, drastic changes had to be made in advertising strategies. The success of both Merlin and Simon has been attributed to the growing adult market and to advertising that pinpointed that market.

Against this background of change and market overflow, cautious hesitation has been the hallmark of manufacturers and retailers in 1981. Retailers have tended to order only the items that sold well last year, or new entries that will support heavy promotional campaigns. Manufacturers are equally circumspect. Parker Brothers, for instance, is introducing only one new electronic toy, Reflex. In response to retailer attitudes, Milton Bradley is launching Dark Tower with a $1 million advertising blitz.

Despite the revolution's ups, downs, and occasional feelings of gloom, no one is ready to write off electronic toys. Even with the Christmas market glut, electronic toys last year accounted for $476 million of the toy industry's total $4.6 billion in sales, and optimistic manufacturers predict a strong showing through 1982. An even more cheerful outlook comes from International Resource Development, a Connecticut research firm that expects electronic-toy sales to increase by five percent a year until 1990.

Designers Under Wraps

Each year, toy companies spend about $243 million on advertising to capture the hearts of kids and adults. Plans for the 3000 to 4000 new toys introduced each year are kept tightly under wraps, guarded as closely as the strictest of military secrets. Only a few toys will win continuing berths in the total market of about 150,000 items. And even if a toy scores a resounding success, its manufacturer often can count on only one year of big profits before imitations flood the market. Because toy makers channel as much as 10 percent of all profits into research, protecting their ideas is a high priority.

Milton Bradley tucks its 100 designers and engineers away from casual passersby, in a building across town from the company's administrative headquarters. About one-fifth of the design and engineering group concentrates on electronic items, and another fifth works on toys aimed at Christmases two to four years in the future.

Parker Brothers keeps its 30 designers hidden in a web of corridors in the firm's main plant. "It's like going through a maze," one employee said. "You could never find the designers without a map." Designers are forbidden to speak with outsiders, lest they leak a telltale clue about future playthings. Their enclaves are protected by locked doors and paper shredders.

Ditomassi described designers as "a different breed of cat," people who need both the freedom to be creative and the discipline to get the product out.

"My job combines the weird and the wonderful," said Jesse Horowitz, design director for General Mills Toy Marketing. Horowitz spends about 10 percent of his time brainstorming and the rest putting his ideas into toy form.

In most large toy companies, designers mull over hundreds of ideas, bringing about 50 to the model stage. Of these, the designers present about 30 to company management. A handful of the 30 models are developed for presentation at the annual February toy fair in New York. After studying the response, the company decides which will appear as finished products on toy store shelves the following November and December.

The Fascination Factor

What is it about electronic toys that holds adults and children enthralled for hours?

"I call it the fascination factor," says Susan Laber of the child development program at University of Chicago Medical Center. "Children are immediately interested in things that go beep and boop. They sense a challenge."

Laber notes many electronic toys are versatile, promoting independence when played alone and cooperation when played with a group. Playing a game can improve manual dexterity and visual motor coordination, she says, and can help a child develop logic.

"Game strategy and plans are developed along with academic things like arithmetic, and prereading and reading skills," Laber says. Because they provide immediate responses, computer toys also furnish positive reinforcement. "These toys structure a child's fantasy much the same way a book does," she continues. "When playing a game, the child can imagine himself as part of it, fitting into a certain role."

Electronic games also may help prevent future-shock by acclimating children to the fact that computers will be playing increasingly large roles in society.

Tomorrow's Toys

In the ever-changing toy industry, predictions about future trends abound. Despite the failure of Milton and Say It Again, Sam, some industry analysts still point to speaking toys as the next rage. All that are needed, they say, are a better-developed, less expensive speech chip and a designer to create a whiz-bang game with speech as an essential ingredient.

Other experts are eyeing the $1.2 billion video-game industry, which is expanding at supersonic speeds. Introduced nine years ago, video games snatched sales from the cardboard-game manufacturers. When those manufacturers developed electronic games a few years later, they managed to grab back some of those gains. This year could be another switch, with the glut of electronic toys allowing another video expansion.

Predictions aside, no one can really explain what makes one toy a top-shelf item and another a stiff. Even designers struggle to define the popularity phenomenon. "Most toys fail," says one employee of Texas Instruments. "You can do all the marketing and research in the world and never have a hit. The winning toys succeed because they have random action and a dash of magic." ■

A Close Look at the IBM Personal Computer

by Stan Miastkowski

As the small-computer market grew over the past few years, it became inevitable that the major computer companies would join the fray. Despite its seeming aloofness and reluctance to admit that anyone would ever need or want a small computer, rumors had been rife that IBM would enter the market. But like soothsayers' predicted doomsdays, the expected dates for IBM's small-computer introduction slid by quietly with nary a peep from the people in Armonk, New York.

Early this year, the rumor mill began to grind furiously. All sorts of people, each one claiming to have "inside sources," came forth with "the truth." Unfortunately, most of the stories conflicted. By midsummer, a more accurate picture of IBM's small computer, codenamed "Acorn," began to emerge. The big question was the price. Rumor had it that it would be as low as $800.

In late August, the predictions abruptly ended, as the IBM Personal Computer was introduced at a press conference in New York City. IBM, one of the most secretive of the computer companies, had surrounded the development of the Acorn with security that would do the CIA proud. Even though many of the details did leak out before the official introduction, there were still a number of surprises.

Stan Miastkowski is the managing editor of Popular Computing.

The Official Word

The IBM Personal Computer had been under development for more than two years at IBM's Information Systems Division in Boca Raton, Florida. Sources there said that although the internal design (known as the architecture) was fixed a long time ago, the available accessories and physical appearance of the computer changed numerous times, and the final "package" wasn't decided on until some two months before the introduction.

Interestingly enough, at the same time IBM was going through its initial design phases, it was also talking with the Japanese electronics giant Matsushita (best known for its Panasonic, Quasar, and Technics brand products) about having an IBM personal computer designed and built in Japan. Obviously, in the design sweepstakes, the domestic model won out. Parts of the IBM Personal Computer system are, however, made in Japan, including the video display and the printer, which is the well-known Epson MX-80 bearing an IBM logo.

> Like soothsayers' predicted doomsdays, the expected dates for IBM's small-computer introduction slid by quietly with nary a peep from Armonk, New York.

The official news hit Wall Street and the mass media by storm. Now that the smoke has cleared, let's take a close look at IBM's brainchild.

IBM's Personal Computer is both *more* than expected, and *less*. The company's well-orchestrated, splashy press conference was designed to offer little more than a tantalizing glimpse of the Personal Computer. Under the heat of deadlines, numerous questions weren't answered—or asked. These are some

observations:

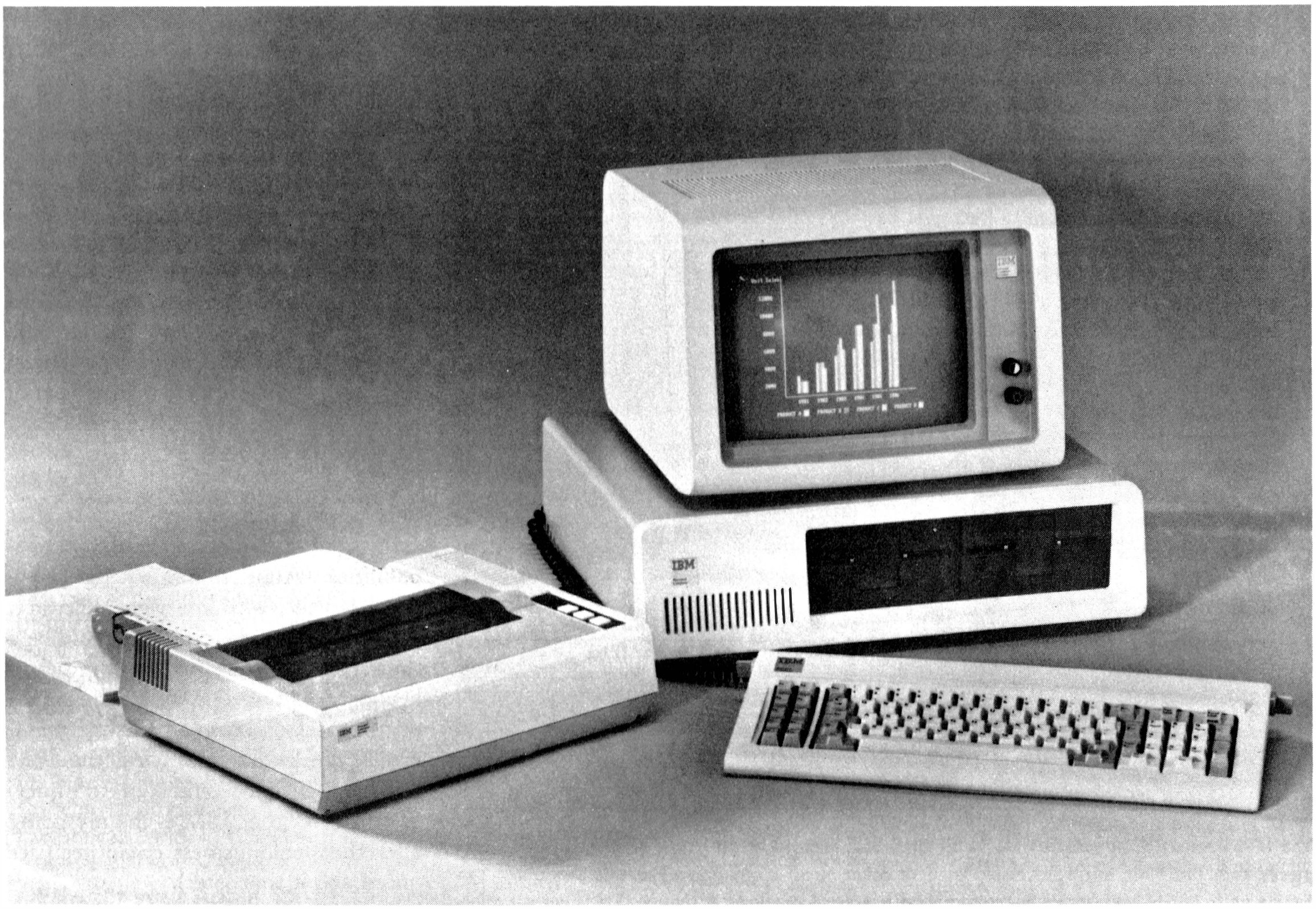
- •Even though it's the first of the second generation of small computers, the IBM Personal Computer is *not* a revolutionary product.
- •Despite the fact that the Personal Computer uses an advanced microprocessor, *none* of the software IBM is presently selling takes advantage of the microprocessor's capabilities.
- •IBM introduced the unit with a paltry lineup of software. Had any of the other small-computer companies done that, it would have been laughed at. (IBM is, however, actively soliciting software from outsiders.)
- •The IBM Personal Computer has the capability to generate better color graphics than ever seen in small computers. However, again, there is presently no software that takes advantage of the machine's capabilities.
- •Color graphics, very useful in small-business applications, are considered essential for a computer to be a rousing success in the consumer arena. Yet, the lowest-priced configuration of the machine offers only black-and-white capability.
- •In an age in which manufacturers are designing all-in-one computers (all the components are together in a single unit), the design of the IBM Personal Computer is a throwback to the early days of small computers. In a move apparently planned to make future design changes easy, the keyboard, electronics, and video display are all packaged separately.

But the indisputable fact remains, the IBM Personal Computer will have a major impact on the small-computer market. It will force other manufacturers to rethink their design and marketing strategies and will guarantee that the small computer will be accepted as something other than a passing fad.

The Price List

Pundits who predicted that the number-eight company on the *Fortune 500* list would come out with an extremely low-priced machine that would blow everyone else out of the water were disappointed. In pricing its Personal Computer, IBM took a cue from Detroit. For $1565 you get basic transportation—very basic. In its press packet IBM readily admitted that an "average" system will run about $3000 and an "advanced" system will cost a bit over $6000.

IBM's "official" price list is a confusing jumble of options and additions that would make any automobile salesman green with envy. With the company's complicated pricing formula it's difficult to figure out what exactly you'll need

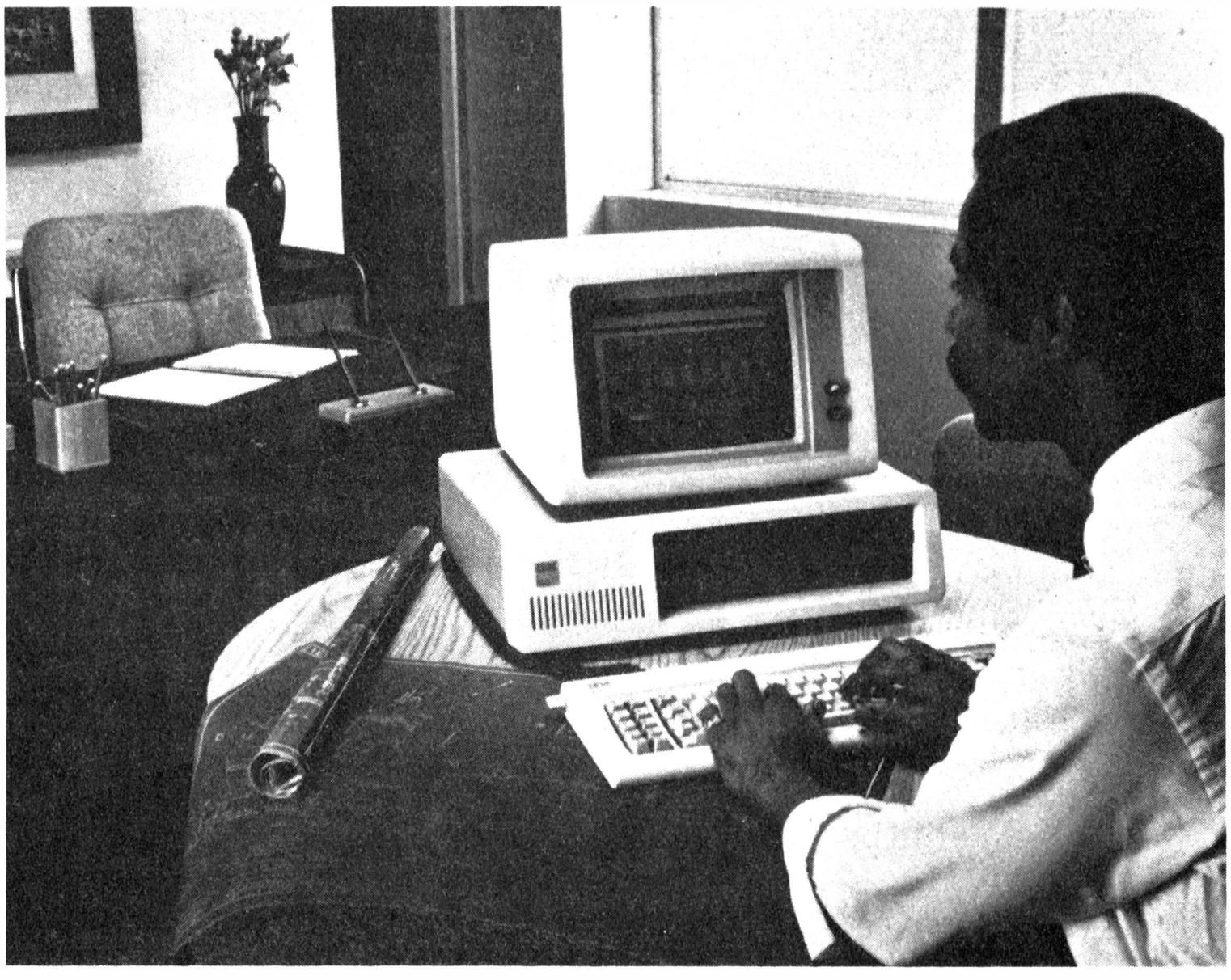


The IBM Personal Computer system. As pictured here, it is a typical business system (with a black-and-white video display) and carries a list price of $4385, without software. The microprocessor and its associated electronics are housed in the box shown underneath the video display. The printer is a Japanese-manufactured Epson MX-80 with an IBM logo. A similar system with color capabilities is priced at about $6000.

and how much it will cost. Here are a few examples: the base unit lists for $1265, but you need a $335 adapter to connect it to IBM's black-and-white display ($345) or your own black-and-white television. (The same adapter also hooks up a printer to the computer.) If you want color, you need the Color/Graphics adapter, which sells for $300. You can then hook up your computer to your own color TV or to an IBM high-resolution color display ($700). The black-and-white adapter has a printer adapter. But if you buy the color adapter and want to use a printer, you'll need a printer adapter, which is an extra $150. (The printer sells for $755. The printer cable is $55.) Disk drives are $570 each, but in order to use them you'll need a disk adapter ($220). If you want to play computer games, you'll also need a game control adapter, which sells for $55. If you want to hook up a modem to communicate with other computers or "information utilities" such as The Source, you'll need to buy the Asynchronous Communications adapter ($150) and Asynchronous Communications software ($40).

A spokesman at Apple Computer Company, who had been waiting for the IBM introduction, called it a "pretty competitive machine for small-business users, but not competitive at all at the low end." A Radio Shack spokesman expressed much the same view.

With the introduction of its Personal Computer, IBM is entering the general consumer market for the first time. In addition to being sold by IBM's Product Centers and by a special sales unit set up within the company, the IBM Personal Computer will be sold by many of the nearly 200 ComputerLand stores. And in what will be one of the first tests of a small computer's mass-market appeal, the IBM Personal Computer will be sold by a new chain of Sears, Roebuck and Company's business-machine stores. Five test stores opened recently in the Boston, Dallas, and Chicago areas. It's obvious, however, that Sears is treading carefully. A Sears spokesman was quick to point out that his company has no present plans to market the IBM Personal Computer in its catalog or general retail stores.



The IBM Personal Computer uses a 16-bit Intel 8088 microprocessor that handles data in larger pieces than the 8-bit microprocessors used in other small computers. The microprocessor can handle up to 262,144 characters in the computer's internal memory. Although IBM is not yet offering any software that takes advantage of the microprocessor's advanced capabilities, it is actively seeking independent programmers to write programs for the machine. Among the programs IBM is offering is the popular VisiCalc electronic spreadsheet (shown here).

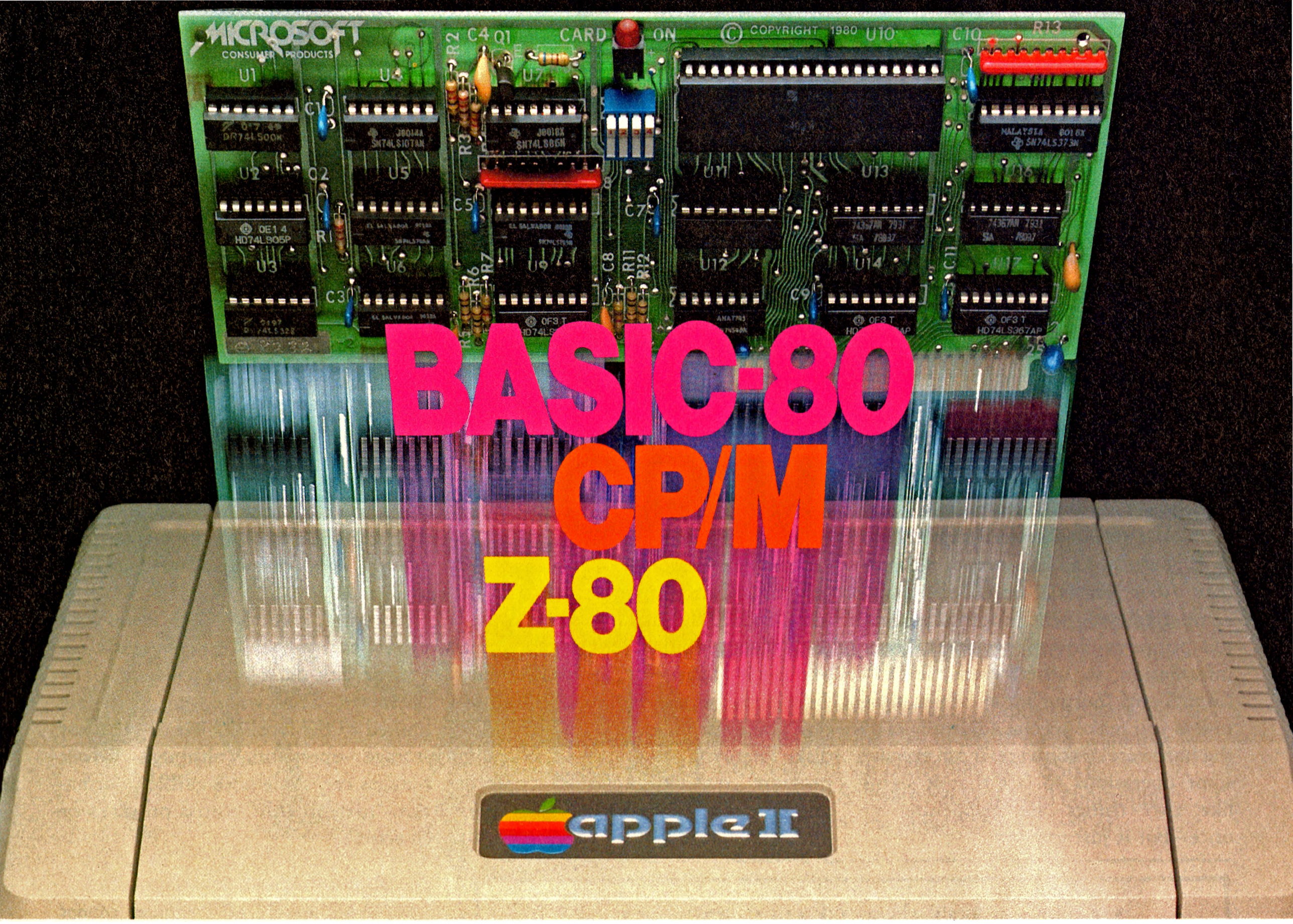
The Brain

The brain of the IBM Personal Computer is an Intel 8088 microprocessor that handles data in 16-bit segments instead of the 8-bit pieces that all other small computers now use. There are two immediate advantages to a 16-bit microprocessor: it's much faster and can handle a much larger amount of internal computer memory. The strange thing about the IBM Personal Computer is that it doesn't really use any of the 8088's advanced capabilities. In most applications for which the IBM Personal Computer will be used, the extra speed is not a great advantage, since most small computers aren't required to handle the vast amounts of data their big brothers do.

However, the microprocessor's capability for handling large amounts of memory could have far-reaching implications. The most memory an 8-bit microprocessor can handle is 64 K bytes, with many having an upper limit of 48 K. The 16-bit microprocessor in the IBM can handle up to 256 K. (Each K is 1024 bytes, so the total the IBM can handle is 262,144 bytes.) In the long run, this means that advanced software (which requires a great deal of memory) will be available for the IBM Personal Computer, although, as we mentioned earlier, IBM is not presently offering any software or features that really take advantage of the system's capabilities. Another tantalizing possibility is that, with the right software, the IBM Personal Computer could be a time-sharing system, with a number of keyboards hooked up to the main microprocessor. A great deal of memory is needed for this, and the IBM could do it. This would seem to underline the fact that IBM is mainly going after the small-business computer user (more about that later).

The Software Question

IBM introduced a surprisingly short



Turn your Apple into the world's most versatile personal computer.

The SoftCard™ Solution. SoftCard turns your Apple into two computers. A Z-80 and a 6502. By adding a Z-80 microprocessor and CP/M to your Apple, SoftCard turns your Apple into a CP/M based machine. That means you can access the single largest body of microcomputer software in existence. Two computers in one. And, the advantages of both.

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CP/M for your Apple. You get CP/M on disk with the SoftCard package. It's a powerful and simple-to-use operating system. It supports more software than any other microcomputer operating system. And that's the key to the versatility of the SoftCard/Apple.

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BASIC included. A powerful tool, BASIC-80 is included in the SoftCard package. Running under CP/M, ANSI Standard BASIC-80 is the most powerful microcomputer BASIC available. It includes extensive disk I/O statements, error trapping, integer variables, 16-digit precision, extensive EDIT commands and string functions, high and low-res Apple graphics, PRINT USING, CHAIN and COMMON, plus many additional commands. And, it's a BASIC you can compile with Microsoft's BASIC Compiler.

More languages. With SoftCard and CP/M, you can add Microsoft's ANSI Standard COBOL, and FORTRAN, or Basic Compiler and Assembly Language Development System. All, more powerful tools for your Apple.

Seeing is believing. See the SoftCard in operation at your Microsoft or Apple dealer. We think you'll agree that the SoftCard turns your Apple into the world's most versatile personal computer.

Complete information? It's at your dealer's now. Or, we'll send it to you and include a dealer list. Write us. Call us. Or, circle the reader service card number below.

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list of software for the Personal Computer. Included is a DOS (disk-operating system) that you must buy in order to use floppy disks. An extended form of BASIC is also included with the DOS. VisiCalc, the famous electronic accountant's sheet, is available ($200), as is the EasyWriter word-processing package ($175), and three general business programs from Peachtree Software ($595 each). For game aficionados, there's also the well-known Adventure game ($30).

IBM says it will publish the technical specifications of its disk-operating system, enabling programmers to adapt existing software to the IBM Personal Computer. How difficult the adaptation process will be depends on the software. Some will require minor modifications, some a major rewrite.

A Change in Philosophy

In regard to software, IBM has always been known as the "do-it-ourselfers"—with all software developed by its own programming staff. But for the Personal Computer, IBM has come to the realization that in order to make it in the consumer market, it's going to have to offer a wide selection of software, from games to business programs. Therefore, IBM is *actively* soliciting outsiders to develop software for its computer. It is also encouraging its own employees to write programs by selling them computers for 40 percent of list price and giving them two years to pay.

IBM has set up a special group to work with outside programmers and will offer the authors royalties for programs that are sold through IBM. It's also making available two software packages (called development tools) to help people write programs that will take full advantage of the Personal Computer's powerful microprocessor. The packages are UCSD Pascal and the CP/M-86 operating systems. Their price and availability are expected to be announced about the time this article appears.

Whether a large cottage industry of software writers and companies develops around the IBM Personal Computer (as it has around the Apple and the TRS-80) will be crucial to the computer's success.

In its most basic configuration, the IBM Personal Computer costs $1565. Included are the keyboard, the system unit (shown on the stand under the television), and 16,384 characters of internal memory (16 K). This system, which IBM calls "entry level," does not include a video monitor. The system can be hooked up to a normal television, but can only display black-and-white graphics. The computer has built-in music capacity. (Note the display on the TV screen, a program that IBM has not yet made available.)

Where's the Market?

In the opinion of most industry analysts, the hottest part of the small-computer market is in the $5000 to $8000 range, with systems aimed directly at small-business users looking for their first computer. In this price range, the IBM Personal Computer is *very* competitively priced. In fact, a market analyst at Apple Computer predicted that it may cause the long-predicted "industry shakeout"—not of the large entrenched manufacturers, but of the many small companies now putting together and selling systems in that price range.

IBM is definitely putting most of its marketing "chips" into the small-business market, where some 80 percent of small computers are sold today. (There are also persistent rumors that IBM will soon offer a hard-disk drive, an expensive accessory that only a businessman would want. There's already a place to plug it in on the computer's back panel.)

What Does It All Mean?

With the entrance of IBM into the small-computer market, all bets are off about when the market will take off. For years, IBM stood by while companies such as Digital Equipment Corporation whittled away at IBM's market share by producing better and

cheaper minicomputers. As far as the small-computer market was concerned, IBM wasn't willing to admit publicly that it existed.

The day IBM brought the Acorn to light, the whole picture changed. Suddenly, the small computer (or, if you will, the personal computer) became a valid entity. "If IBM is making one, there must be something to it" was a cry echoed throughout the business community.

The general prediction was that the "small-computer explosion" would not be until the late 1980s. IBM has changed that. Its Personal Computer has added much ammunition to the fire. People who have been reluctant to purchase a small computer will now most likely jump on the IBM bandwagon. In addition, the millions of dollars that IBM will spend on advertising the Personal Computer will increase the entire market. The end result will be a bigger "pie" for Atari, Radio Shack, Apple, Commodore, and others.

In 1977, when small computers first became available, about 75,000 were sold, mainly to hobbyists. The market has continued to grow. By the end of this year almost a million units will have been sold. A major market-research firm has predicted that with the availability of the IBM Personal Computer, some *five million* personal computers will be in use by the end of 1985. Currently, IBM is set up to manufacture about 100,000 small computers a year. (Apple makes about 96,000, Radio Shack, 130,000.) To keep up with the increase in demand, all the companies will have to increase production.

In sum, the IBM Personal Computer is not as technically innovative as had been expected. But everyone who's involved with computers owes IBM a debt of gratitude. Suddenly, the personal-computer industry is established. ■

At a Glance

Name: IBM Personal Computer

Use: Business, professional, educational, and home

Manufacturer: IBM Corporation, Information Systems Division, POB 1328, Boca Raton FL 33432, (305) 998-6007

Base List Price: $1265

Typical System Price: $1565 to $6000

Standard Features: Intel 8088 16-bit microprocessor; 83-key detachable keyboard with adjustable typing angle; 10 special-function keys; upper and lowercase character display; power-on self testing; Microsoft BASIC in ROM (read-only memory); high-resolution black-and-white graphics (640×200 elements); capability of mixing graphics and text on the same screen; music generation

Optional Features: Up to 256 K bytes of RAM (random-access memory), 5¼-inch floppy-disk drives (store 160 K per drive); high-resolution color graphics, (displays up to 16 colors, four-color graphics resolution of 320×200 elements); RS-232C interface for hooking the computer to the telephone lines and other accessories; Epson MX-80 132-column bidirectional dot-matrix printer; high-resolution black-and-white video display with green-phosphor screen; high-resolution RGB (Red-Green-Blue) color video display

Software Available: Extended BASIC and DOS (Disk Operating System) on floppy disk $40
Pascal compiler $300
UCSD Pascal language system (price to be announced)
Communication software $40
VisiCalc $200
EasyWriter word processing package $175
Adventure game $40
General Ledger $595
Accounts Payable $595
Accounts Receivable $595
CP/M-86 advanced operating system (price to be announced)

Who's Minding the Computer Store?

An investigative report on how small computers are sold

Illustrations by Jonathan Graves

by Phil Bertoni

The question came up: What would happen to a complete dummy who walked into a computer store? There was a pause, during which everyone turned to me. I cleared my throat with assumed modesty, secretly pleased at the apparent high regard for my opinion. The light didn't dawn for some time, and the others became secretly pleased at the rightness of their initial assessment.

And so the dummy went forth on a tour of retail computer stores throughout the Northeast, into cities, towns, and dark malls. Acting utterly naive (if not to say ignorant) about computers, I strolled into retail computer establishments willing and eager to buy a microprocessor system. And what happened? Nothing. Nothing immediately bad, anyway. For a variety of reasons shortly to unfold.

While preparing for this assignment (which involved canceling my membership in the Association for Computing Machinery and forgetting everything I ever knew about computers so I would present the unsullied aspect of the perfect sucker), I formed a set of expectations as to how the naive customer might be treated. I expected that I might be lied to and deliberately misled, my apparent ignorance mined for quick wealth. I thought that knowledgeable salespeople might snow me with jargon and technical terminology until I signed the sales order in a blizzard of despair. I feared that I might be high-pressured into purchasing far more equipment and software than I could possibly use. I also expected that the reverse might prove true: salespeople might promise much more than a given system could deliver, selling what they *had* rather than what I needed. I did *not* expect to be feared and shunned. But that, by and large, is what happened.

No high pressure. In fact, pressure was so low it felt like an outright vacuum. It's a telling commentary that out of 16 stores I visited (selected to give a good mix of types and locations), only one furnished a fully satisfactory experience. Satisfaction in this case meant knowledgeable personnel who were willing to spend time enlightening the ignorant (and who were more or less successful at it), well set up demonstrations, and at least an indication that the computer-store friendliness wouldn't end when the computer and the store parted company. In short, only one store made me feel like giving them my money. In all fairness, two other establishments hinted at being satisfactory and failed only circumstantially.

But we'll save the honeys for last. Right now, let's look at how the bazaar is set up and how bizarre it can get.

Sideliners and Mainliners

In general, if you're completely uneducated about computers, the specialty stores (where the specialty might be business equipment, or stereo systems, or New Age books) fall into the sideliner group. These outfits feature salespeople who, as a rule, could be said to be interested in computers only because they fear to admit to their apathy.

Mainliners include computer chain stores (yes, they already exist) and independent computer retailers with one, or at most two, stores. In these you find more or less knowledgeable salespeople who, for the most part, can't get that knowledge across to the customer.

The Setup

Now, it ain't easy being dumb, as any fool knows. In this particular endeavor, the trick was to always appear a little less savvy than the salesperson. Often this was not easy – in some cases, trying to be less accomplished involved the surrender of certain basic motor functions.

Acting utterly naive (if not to say ignorant) about computers, I strolled into retail computer establishments willing and eager to buy a microprocessor system.

retailers don't want to see you. The sideliners don't want to see you ever, and the mainliners don't want to see you – yet. A sad state of affairs. In fact, if it applied to auto sales, we'd all be on horseback.

The distinction between sideliners and mainliners reflects rather precisely the two kinds of treatment you can expect when you're shopping for your first personal computer. These two broad categories represent a total of four kinds of retail establishments where you can buy personal-computing systems.

In the sideliner category are those stores that are not dedicated to selling computers and that peddle them as one of several lines. Department and

At times, I admit, I was obliged to be cruel. Like when the clerk launched the sales spiel with "Now, this is a 48 K machine," and rattled off a set piece about RAMs and PROMs and disks and drives and green-toned monitors and thermal versus impact printers, and I nodded eagerly and intelligently throughout the entire presentation and inquired at its end, "What's a 'K'?"

I used several different ruses. I professed to be interested in a home computer purely for the checkbook-balancing and games aspects of microcomputer use. Or I claimed to be the proprietor of a small business and inquired about automating the invoicing and inventory-control procedures in my operation. Varying the intensity

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of the business application from store to store, I hoped to smoke out any tendencies toward over- or under-selling.

For some cases, I concocted a business application so trivial and so small in volume of data that it wasn't worth computerizing. For others, I described an operation that would exceed the capacity of any personal computer. And in a few cases, the business application I presented would dictate a certain level of processing power in the computer system, requiring, for example, a minimum of two disk drives for the amount of data to be processed.

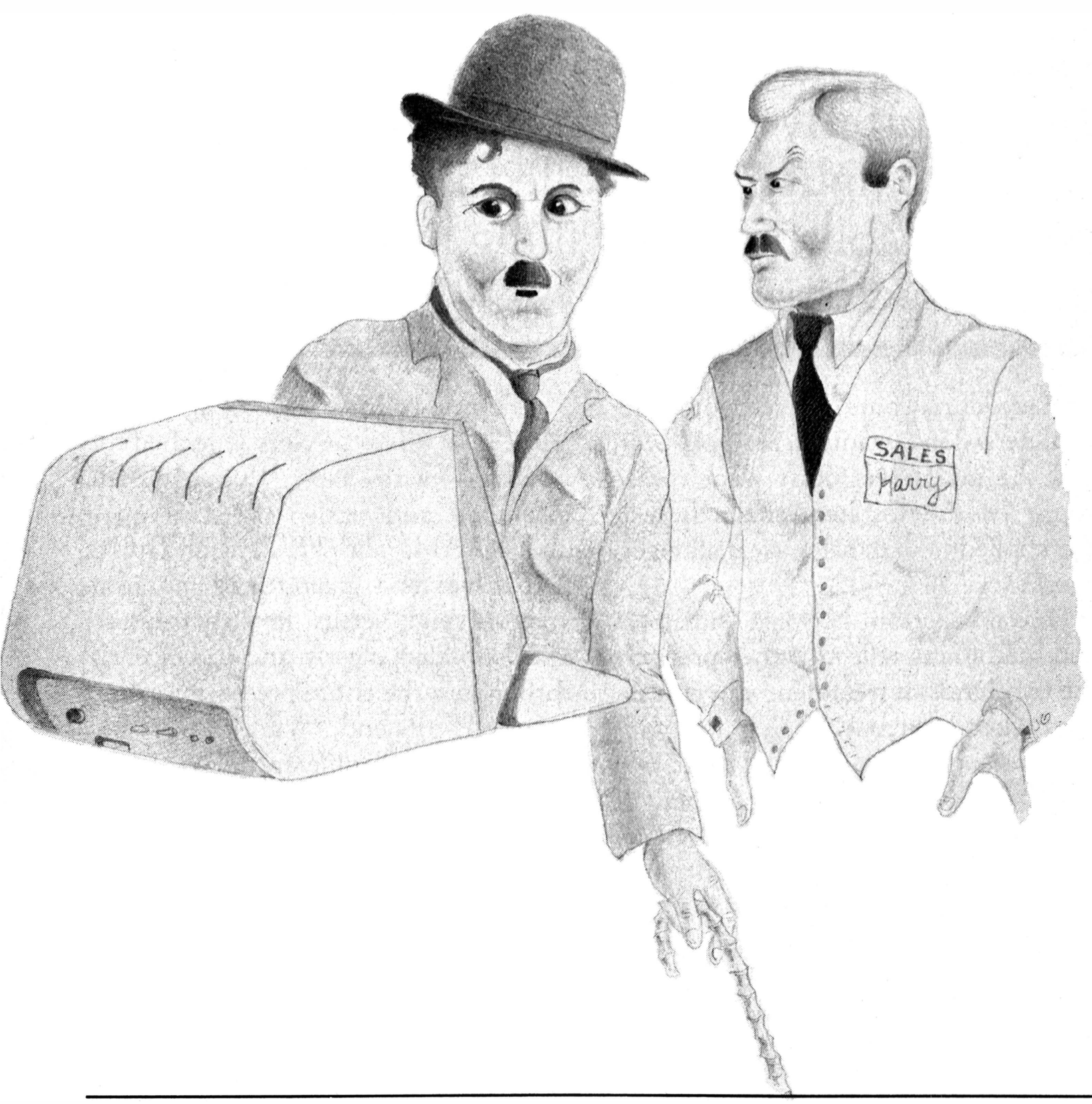
I expected that, at least in some instances, salespeople might try, either through ignorance or deception, to sell me a system ill-matched to the proposed application. That never happened. In most cases, the sales clerks did not even hazard a guess as to how much system I might need, choosing to defer that decision to me when I became better educated. However, in the few cases where they did specify (in a tentative and preliminary way) a system configuration, they were correct in their assessments and pricing. That was a comforting discovery.

But right as they may have been, the latter clerks did not inspire much confidence. If I hadn't known in advance that the specification was correct, their lack of ability at explaining things would have left me doubtful.

After a sufficient number of samplings, a pattern concerning the behavior of retail computer establishments and their treatment of the computer-naive customer emerged; a pattern that can be summarized like this:

- Ignorance is not bliss; it is a curse.
- Most personal-computer salespeople are well intentioned but under informed.
- In the current state of the market, you can't really expect to select and purchase a microcomputer without a little education in advance.

In short, you can't quite buy 'em off the rack yet. Because here's what happens.



Ignorance is a Curse

Computer salespeople are not happy to see a complete computer novice walk in the door. In most places, I felt as welcome as an inquisitor at a black mass. Actually, they weren't totally hostile – they just wished I wasn't there. The reasons for this lack of hospitality seemed to cleave neatly along sideliner/mainliner boundaries. Sideline people as a rule didn't understand the product very well (they have other things to sell, too), and were embarrassed at having to answer my questions with "I don't know." (To their collective credit, I didn't run into any clerks that pretended to knowledge they didn't have, although honest misconceptions abounded; more about that later.) At any rate, these folks would rather have been writing up sales slips for electric typewriters than trying, with scant resources, to educate me.

Paradoxically, mainline sales personnel were also less than ecstatic to see me. They were much more knowledgeable, and therefore less prone to humiliation, but their expertise equipped them to know what a chore it is to try and educate a complete tyro – at least to the point where the tyro feels comfortable shelling out cash. In general (with a notable exception or two that I'll mention later), these unwilling instructors preferred that I do my homework and return later. They obviously weren't interested in teaching CompSci 101.

Just how tough can it get, this ignorance about computers? Let me give you a couple of studies from my own casebook.

Morning in Manhattan. I strolled into a business-equipment store that sells computers as a sideline. Looking well groomed, expectant, and very much on the *qui vive*, no one suspected how stupid I could be. Several clerks were standing about. One sharp fellow detached himself from the herd and hurried over, with the easy floor-eating strides of a born showroom predator. The scent was rich in his nostrils. The shine was bright on his teeth. A less-speedy colleague brought up the rear, defeat in his eyes, cursing his own slowness.

"Hi," said the glad-eyed victor, loping toward me with outstretched hand.

"Hi," said I, "I'm interested in personal computers. I don't know much about them."

His face collapsed in ruins. Without so much as breaking stride, he gestured to the runner-up, barked, "Harry here will help you," and swept past in a rush that ruffled my hair. And poor Harry. If there was defeat in his eyes before, despair dwelt there now.

Harry and I repaired to the back room (where the sole floor model was kept) and passed a dismal half hour, a goodly portion of which was devoted to trying to get the system to work for a demo. That failing, we reluctantly tormented one another for a while, like fellow gladiators forced into the arena, me thinking up stupid questions and he trying gamely to find the answers in the manufacturer's programmed-learning manual.

If I never see joy again, that will be all right with me. Because the joy I saw on Harry's face when I announced that I was leaving "to look around a little more" was a pure, inexpressible joy. I now know the look on the condemned man when the governor's pardon arrives. Harry walked me to the door, hand on my shoulder, showering upon me wishes for a long and prosperous and happy life. Then he put me on the sidewalk and went back to the showroom, humming.

A similar situation obtained in the electronics department of a large and famous department store. There I approached an intelligent-looking clerk and announced my interest in personal computers. He was *very* intelligent, as it turned out. He listened to my profession of ignorance, then with eyes wide and innocent said, "Gee, I'd love to help you, but I'm going on my break now. Hang on a sec. Harry!"

This Harry looked up sharply, smelling evil afoot.

"Personal computer. This gentleman. See you, Harry."

The handoff thus complete, Harry stalked over to me, his disgust veiled only by wretchedness. He led me to a microcomputer system disarrayed on a counter. I ran into some disaffected salesmen in my jaunt, but this one took the kewpie doll. Harry announced that this was the only system they carried. By implication, it was one too many. Constant prodding eventually revealed that he knew a bit about the system. But I could see that he wanted me dead. I kept trying to draw him out, game fellow that I am: "Is this all I'd need? . . . What is that box? . . . Can it do checkbooks?" He would tell me (and accurately, within limits), but he wouldn't volunteer any information. After a few minutes he lit the system's self-demo package and abandoned me in front of it. "I'll be back," he growled, but I knew he wouldn't.

I watched the demo to its end, twice. Then I very pointedly started wandering about the sales floor poking at delicate things. But that activity did not restore Harry to my side, though he cast a few sidelong glances. So I eventually left. That made that Harry happy.

Sideliner salespeople seem to be very uncomfortable with the fact that they don't understand what they're selling. It's particularly notable that the hard sell was nowhere in evidence in any store I visited. That's surprising, when you consider that a computer system is probably the highest-ticket item on the sales floor and is eminently worthy of pushing—for points from the manager, let alone commissions. Good thing that Willy Loman never lived to see this day; it would have killed him.

Among the mainline computer dealers, my curse of feigned ignorance was milder, but still apparent. Another case study: I strolled into a mainliner's showroom, settled my vacant gaze on Harriet, who was apparently free, and began my spiel. She listened patiently and then indicated a shelf of books that would be helpful to me in my ignorance. I pressed her for a basic verbal introduction to computers, citing my prodigious fear. She gently hinted that I should return when I was better informed, that now was not the time for sales talk and demos. The conversation began to take on the vague aspect of a Victorian courtship, I insisting, she hinting "no" without ever rudely declining. I persisted, and she eventually consented to a sit-down discussion of applications and equipment. But Harriet was not adept at explanation. She happily watched me leave, on her lips the parting recommendation that I buy some books, or at least go to the library if I couldn't handle an outright purchase. Then we could talk. I felt as though I were being sent off to Australia to seek my fortune and return with the bride price in hand.

Computer salespeople obviously weren't interested in teaching CompSci 101.

A Lack of Expertise

On my rounds I encountered not a single instance of skulduggery. I was misinformed frequently, deceived never. The point could be made that to work a deception requires a certain amount of expertise.

If you were heading out to purchase a personal-computer system and were not terribly knowledgeable, you'd probably feel a lot better for three assurances:

1) That you will be dealing with honest tradespeople.

2) That you will be getting the right system at a reasonable price.

3) That you will understand what it is you're getting.

Well, the present survey indicates that item 1 is no problem; no one tried to take advantage of my ignorance and push a system down my throat. Item 2 represents a quasi-problem; a majority of the salespeople I consulted weren't expert enough to specify a system (other than the basic package) from my description of the intended applications. These folks just handed me a brochure and a price list. Pick one from column A, two from column B. However, those few who did specify and

price out a system configuration, and did recommend software, were right on the mark. They neither suggested too much system nor too little, and the prices quoted were pretty much those suggested by the manufacturers. The only exception (and it's a mild offense) that I encountered occurred when one salesperson recommended a piece of inventory-control software that was rather more powerful and expensive than the application demanded. But normal shopping-around practices can protect you against such eventualities.

The real problem lies with item 3: understanding what you're getting. You can expect to receive a good deal of misinformation about basic computer lore, and the correct information is apt to be presented in a manner that's confusing to the computer novice. Most often, you receive a set sales talk, in celebration of a particular system, that assumes an essential understanding of computer systems and how they're put together. And interrupting with a question to clear your confusion frequently induces it in the salesperson. It's called conservation of confusion.

Without exception, every sales pitch I heard began with the sentence, "Now this is a 48 K machine." This despite the fact that a professed ignoramus is not going to have the faintest idea what "48 K" means. An interruption here—"What's a K?"—invariably led to the response, "You know, 48 K of RAM," and off again with the spiel. K of RAM? I'm K. of C. What does it all mean? Can I go home now? Almost without fail, salespeople did not bother to explain the terminology as they went along. Some could, when prompted. Many couldn't. By way of example, I was told at one time or another that:

- *48 K represents 48,000 bits of information in the machine's storage.*

(It actually represents 49,152 [1024 × 48] bytes—see below—of programs and data.)

- *RAM stands for "ready-access memory."*

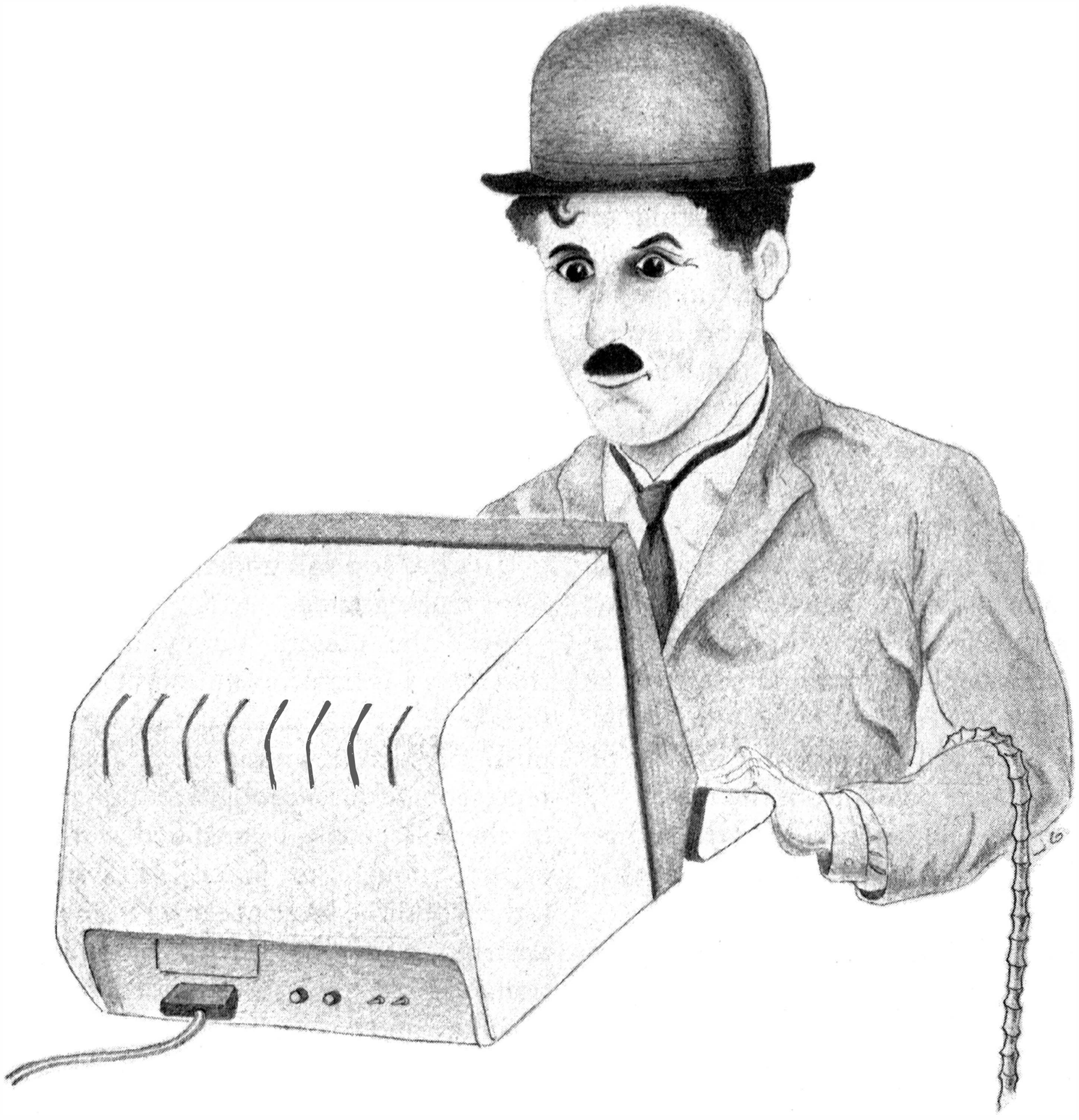
(It stands for "random-access memory," a storage area into which the system can place information, retrieve it, and shuffle it around.)

- *A "byte" is like a number, or it's the same thing as a word.*

(No one hit upon the rather simple and satisfying explanation that a byte is a measure of information, like an ounce is a measure of weight. Never mind that a byte is what it takes to express a character of the alphabet—just point to a display screen full of numbers and text and say, "That screenful of information is about a thousand bytes' worth.")

- *A disk drive is the thing that makes the computer run—like a driver drives a car.*

(A disk drive is a "player" for a magnetic disk, which provides accessory, portable memory for the system in excess of the RAM it comes equipped with. The disk looks like a small phonograph record surfaced with a material similar to magnetic tape. Disks have information and programs recorded on them, which can be "played" into or out of the system at will.)



Even more confusing to the novice than misinformation is the lack of information. For instance, no one ever made it clear, without liberal hinting from me, that the amount of memory a system possessed was related to its capacity for computing. They talked about "adding more RAM," but never mentioned why you might want to. No salesperson, in describing how a system is set up, ever got across the notion of "throughput"—that the number of disks, and of course drives, on a system has something to do with how much information you can process. That fewer drives means more switching of disks; that some disks are used for programs exclusively and others for data; that if you have a large amount of data on disks that you want to be accessible all at once, then you have to install enough drives to accommodate them. And by the same token, the notion wasn't clearly expressed that, in general, the more drives and disks on the system, and the more data to be accessed, the slower the system will be in responding. Elementary concepts, but

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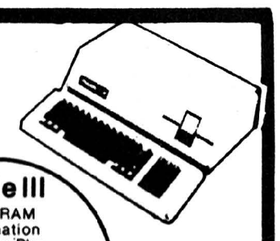

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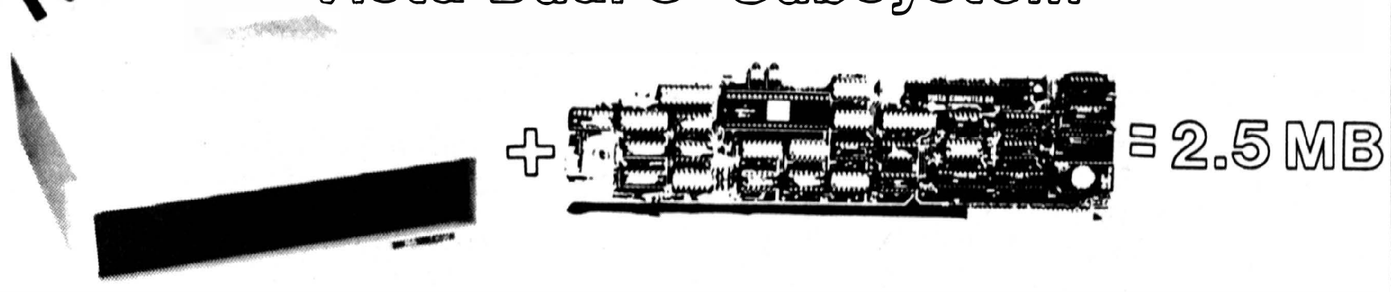

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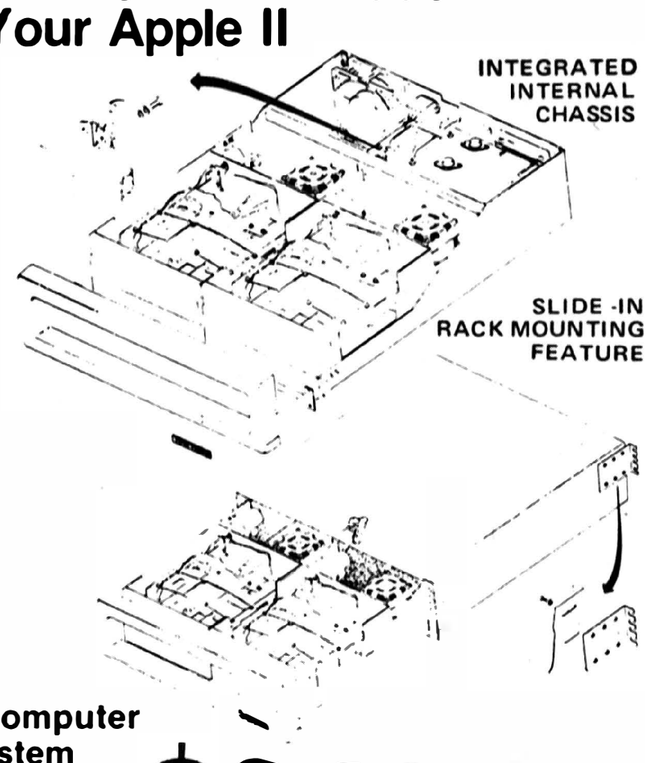

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never covered.

Some salespeople figured, "in for a penny, in for a pound," and nearly broke their health hanging in there, being helpful, answering one question after another. Nearly all would answer with an honest "I don't know," when the occasion called for it. But if you're fearful about computers and desperate to understand them before buying, good explainers are few and far between.

Get an Education

If you're truly uninformed about computers and in the market for your first system, you'll almost certainly have to take Harriet's advice and read up before you seriously attempt to purchase a system. The odds are against acquiring an education on the fly. Unless you've got a knowledgeable friend who can accompany and advise you on a purchasing trip, your best bet is to make preliminary visits to several stores and pick up literature, both brochures and trade books on computers. Then go back better informed, to buy.

In my two near-satisfactory experiences (one a business-equipment store, the other a nationally established retail computer chain), that's pretty much how it went. They asked me a few questions about applications and so forth, quoted a ball-park price, entertained a few questions, and gently but firmly sent me away with readable and informative literature. Both salespeople evinced a willingness to talk about computers endlessly when I knew a little bit more. Self-education is the key.

So you'll know the good stuff when you see it (or alternatively, recognize the bad stuff by contrast and get out of there), I'll recount the finer features of my near-perfect computer-shopping experience. It occurred in what seemed a rather unlikely place—an independent computer retailer's in Greenwich, Connecticut.

When I came into the shop I was met by a saleswoman who did not try to run away, and who turned out to be both knowledgeable and indestructible, unfazed by the most arrant stupidity. After offering me some initial reassurances about personal computers, she began her sales presentation properly with the question "What do you want to use it for?" This is the mark of a pro; by this sign ye shall know them. Rarely had I encountered that extremely sensible question as the first order of business; I almost confessed right there and pinned a medal on her. Instead I gave her both barrels—both the home and business applications. She nodded brightly, said she had just the thing, ushered me over to a display (equipped with a speech synthesizer—nice touch) and began to explain how things worked. She went slowly and invited interruptions.

After covering the name and function of each hardware component of the system, she stopped and took questions. Her main and remarkable talent was the ability to explain concretely. No fudging. When conveying the idea of a "byte" she skipped the abstract definition in favor of example, telling me that the amount of data in the application I had described represented

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about 100,000 bytes of information. Presumably, I had a mental picture of how much information I had to deal with (which I did—I picked the application so I'd need 100 K bytes' worth).

When I inquired what "software" might be, she marched me over to the display rack, opened a packet and showed me, actually *showed* me, a floppy disk. She explained how programs were recorded on it and transferred into and out of the system's memory. No one else ever did that for me, before or after. I wanted to marry her.

After forty-five minutes of patient instruction, she cooked up a demo, on the spot, of the inventory-control application I'd mentioned, using the store's own system (and stock). Then she priced out a system meticulously, on paper, and—get this—invited me to send her some sample information from the business application I'd described. I should return a week later and she would have worked up a custom demonstration, using my own forms and data. How can you beat that? I couldn't. I almost bought the damn system. Hell, I couldn't wait to get back to my imaginary business and try it.

And throughout the entire interview, she conveyed the notion that computers were *fun*. She was perfectly at ease with them, and by extension, the customer should be.

Retail Trends

This sort of treatment is, of course, not universal, and it's not clear that it ever will be. One encouraging sign is that computers as a sideline may be on the way out. Three-quarters of the sideliners I dealt with indicated in one way or another their unhappiness with peddling computers and confided that they were getting out of the business. Selling computers, in their view, was too time- and training-intensive, systems were too hard to sell and costly to stock, and price competition from mainliners was too stiff.

Well, that's good, isn't it? That means we can expect more and more retail computer stores, staffed with personnel trained explicitly for, and dedicated to, computer sales. Well, maybe not. In later conversations with retail vendors, I ran across a rather discouraging trend. Competent and knowledgeable computer salespeople have a high turnover rate. Why? Because when they reach a certain degree of proficiency, they're snapped up by the computer industry. Why should a person who has acquired a certain amount of computer expertise continue to pound the floor at a retail clerk's salary, when that expertise now qualifies him or her for a big-bucks position in sales, marketing, or training with one of the personnel-hungry computer manufacturers? The situation, as they say, is in flux.

Computer retailing is a young enterprise and subject to instabilities—but the consumer can sometimes benefit by taking shrewd advantage of an unsettled situation.

An incident in a suburban stereo store demonstrated that the spirit of free enterprise is still alive and prowling. The store was billed as a dealer for a particular brand of microcomputer. I walked in and went up to the manager.

I could tell he was the manager. He was leaning against the counter, smoking, and no one was telling him not to. Process of elimination

"Hi there," said I, "I'm looking for a personal computer, but I don't know much about them."

He took a long pull on his cigarette, cocked a glum eye at me, and replied, "You and me both, pal." He went on, with disarming honesty, to explain that he hadn't known what he was getting into when he enfranchised himself as a computer dealer. He was too busy to go to the training seminars, he didn't know how to sell the damn things, and as soon as the models he had in stock were sold off, he'd be out of the computer business. He spared me a gruff expression of pity and let me know that he couldn't hope to advise me. Naming several other computer dealers in the locality, he suggested that I inquire thereabouts for hand holding—he wasn't about to dispense it.

I thanked him and turned to go, when he raised a finger to detain me. "And when you get an education from them and figure out exactly what you want . . ." he leaned toward me, grinning, "come back here and I'll beat their price."

I'd rather feel that it's not quite such a jungle out there. There was one bright and good-natured fellow over in the corner repairing keyboards when I eased into a New Age bookstore that did a sideline in micros. The regular computer clerk was out to lunch and various other personnel tried to drive the cursed one from their midst. The keyboard repairman came over and offered his assistance, claiming not to know much, but he'd try to answer questions. He was no computer whiz, but he did know repairs and gave me a flood of inside info on service contracts and the like. It was also apparent that he loved, really loved, computers. As I was about to leave, I thanked him for the information and he stood there in a pile of hardware and beamed.

"Hey, no problem. That's what this is all about." He gestured at the machinery all around. "Information . . . information for the people."

I hope he makes salesman. ■

Computer Graphics

by Stan Miastkowski and Rachael Wregé

Graphics, the presentation of information in a visual rather than textual manner, is the fastest-growing area in computers today. It's not difficult to understand why. If you've ever had to plod through long pages of numbers to project sales or look at inventory figures, you know that it's much easier to take a quick look at a chart or graph. You can see relationships and trends that would be difficult if not impossible to detect in a list of numbers. When you add color, it gets even better.

Until now, small-computer graphics have always been considered the poor cousins of the really fancy stuff generated by large and expensive computer systems. The limitations of memory and microprocessors made it virtually impossible to create highly detailed (high-resolution) graphics with your garden-variety personal computer.

But that's changing fast, especially with memory becoming more and more inexpensive. The large amounts of memory needed for fancy graphics are well within the reach of most small-computer owners. Color capability is also becoming more prevalent, and special software and plotters (printers that print graphics) are now reasonably priced.

The Japanese small computers now hitting the U.S. are right up front when it comes to eye-grabbing graphics capability at low prices. (Look for a review of the Japanese best-seller, the NEC PC-8001, in next month's *Popular Computing*.)

Among U.S. computer makers the graphics scramble continues. Here's what the top four are doing:

•**Apple:** The Apple II was designed around a high-resolution graphics capability. (In fact, many of the most advanced business-graphics software packages are designed for the Apple II.) However, if you want to create your own graphics, you need the skills of an advanced programmer. Apple has recently started shipping a new software package (Apple Graphics II) that makes it easier to produce graphics.

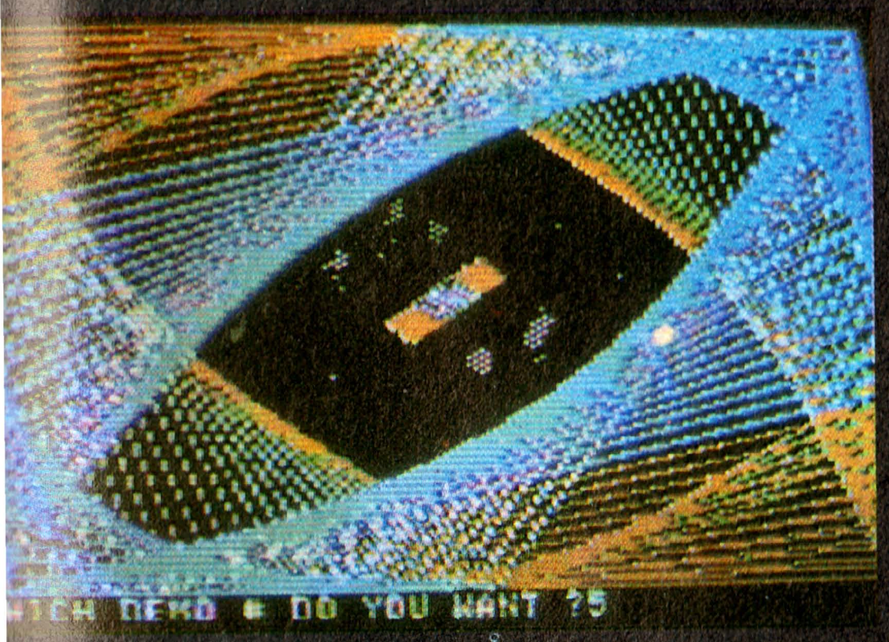
•**Radio Shack:** Tandy is entering the graphics market cautiously. Earlier this year, it introduced Extended Color BASIC for the TRS-80 Color Computer, one of the neatest and least expensive high-resolution color graphics packages ever available. Easy-to-use graphics commands like PAINT, DRAW, and CIRCLE are included in the extended BASIC programming language of the Color Computer. As yet, however, Radio Shack's top-of-the-line small computers (the Models II and III) are black and white and can only produce low-resolution graphics.

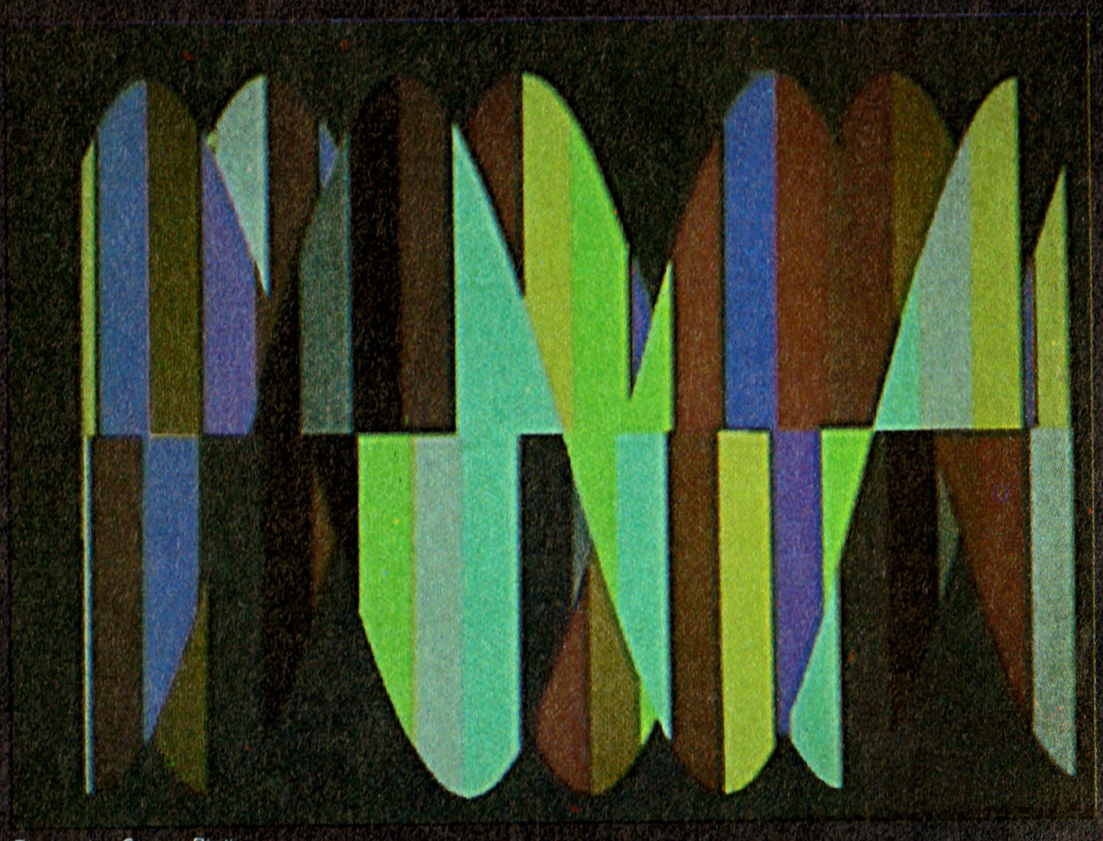
•**Atari:** The company's 400 and 800 small computers are capable of producing excellent high-resolution graphics and have special circuitry to do just that. (What else would you expect from a company whose specialty is those colorful arcade games?) The big "but" is that, as it stands now, the only people who can fully use the Atari's capabilities are advanced programmers. (We note with interest, though, that Atari's recently released business-software packages include some excellent graphics.)

•**Commodore:** The Commodore PET has limited black-and-white graphics. And although the newly released VIC-20 offers color graphics that can only be described as dynamite (especially in view of the $299.95 price tag), a Commodore spokesman said the company remains unconvinced about the need for really complex color graphics for business. He added, however, that they're watching the market carefully.

The eye-popping graphics on the next few pages were done on medium and large computer systems (minicomputers and mainframes). We'll put it to you straight: you can't do things like these on your small computer *at present*. But that will change. New generations of hardware and software put better graphics within the reach of every small-computer owner.

Photo by Ken Kahn





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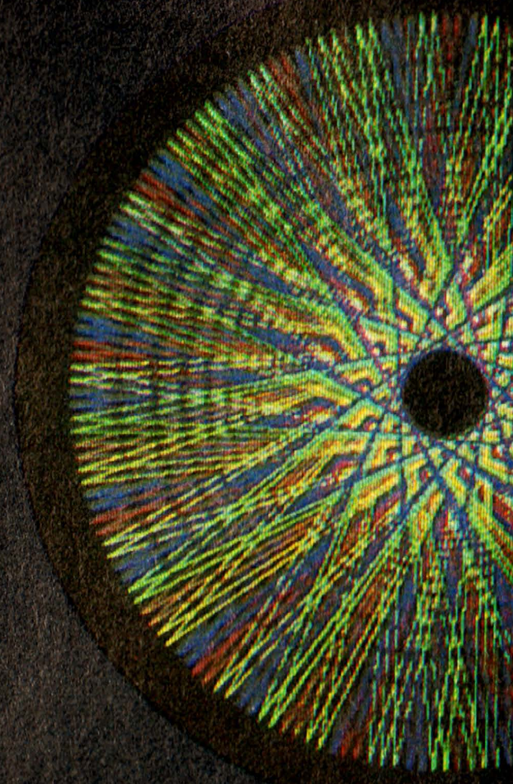
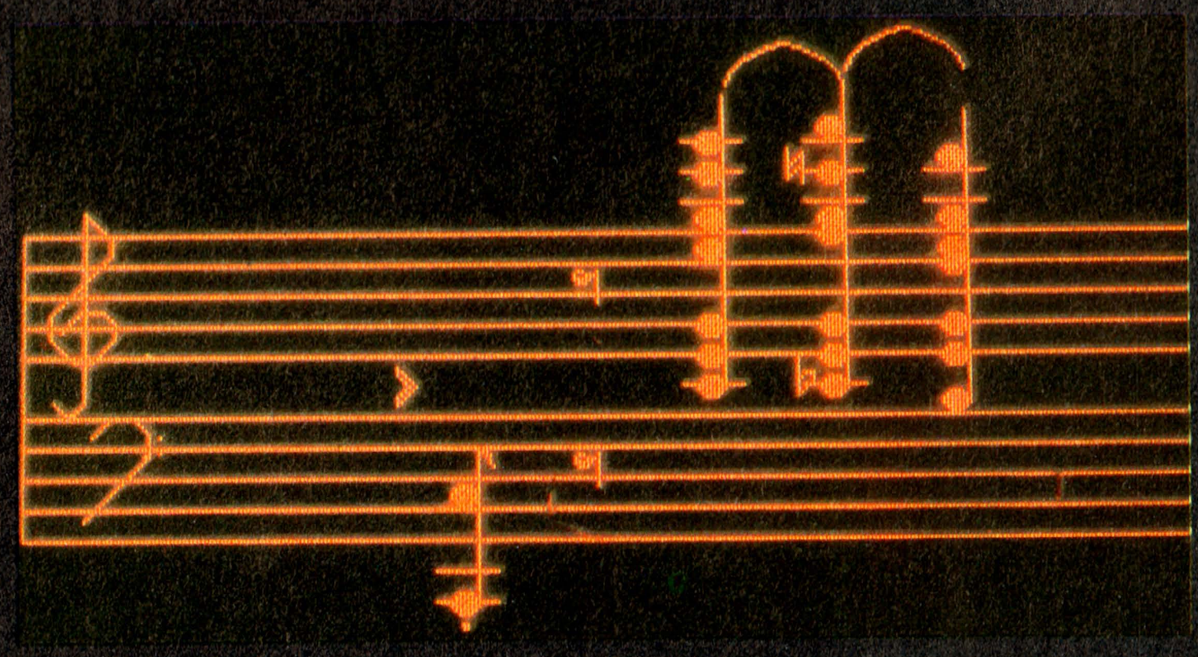
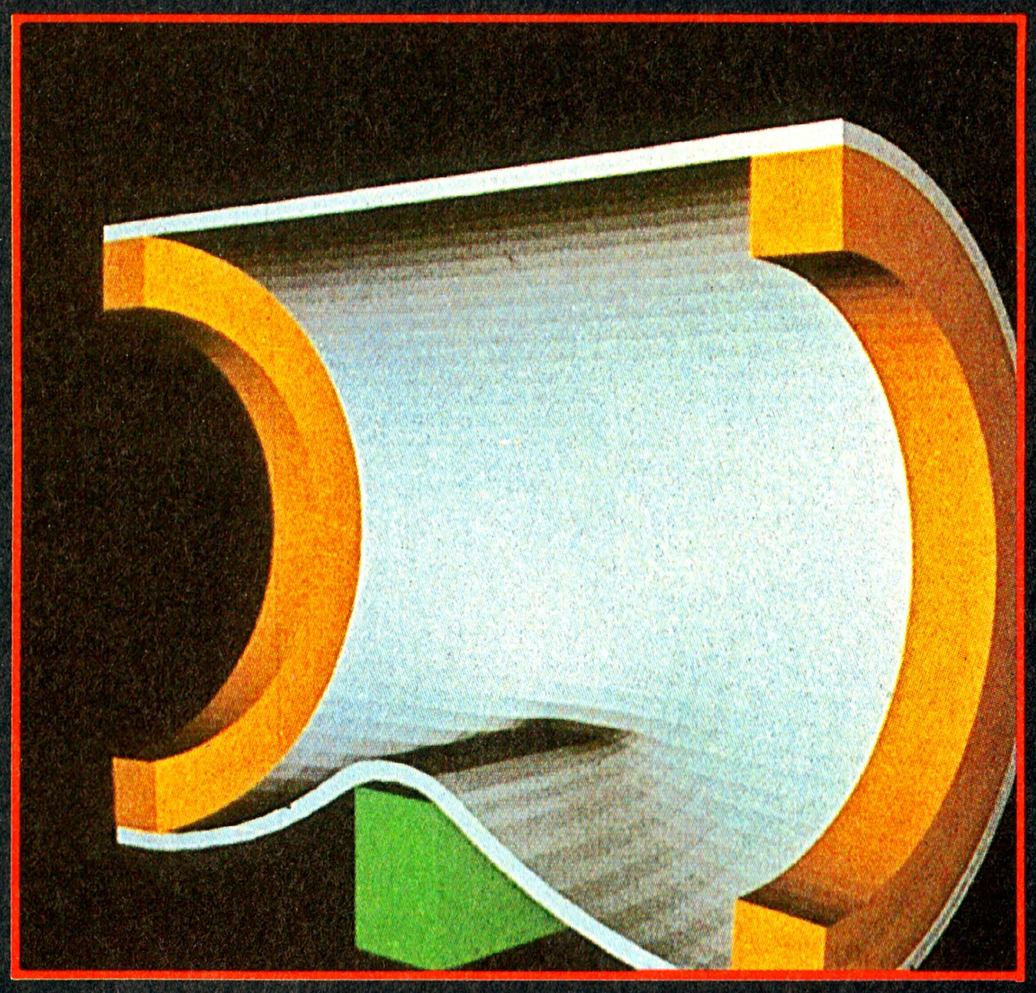


Photo by Henry Lieberma



A few typical examples of color graphics that can be produced on small computers using existing hardware and software. Turn the page to see what's on tap for the future.



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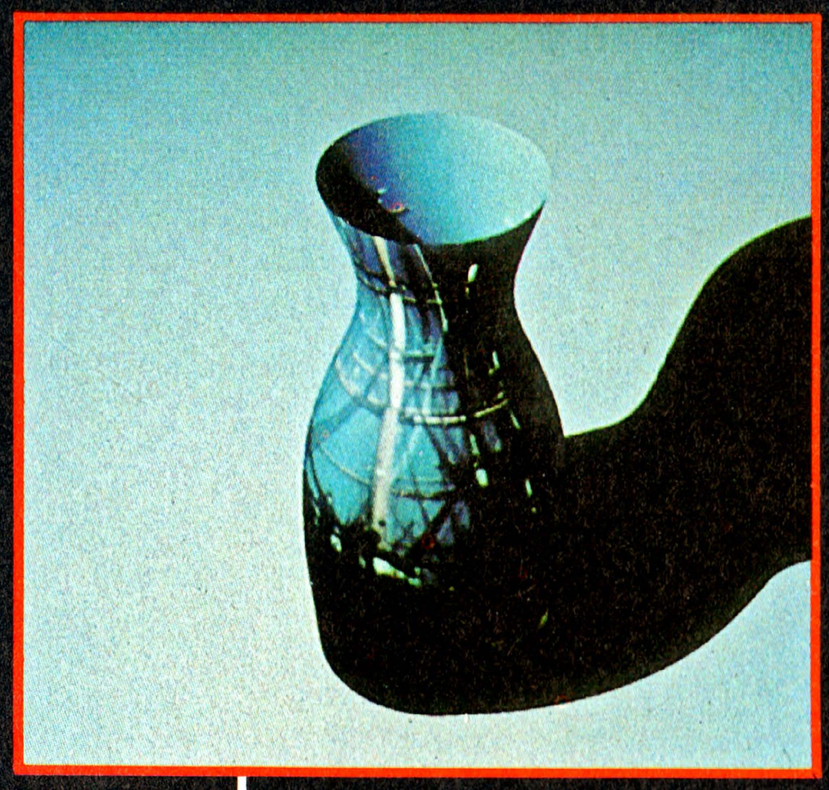

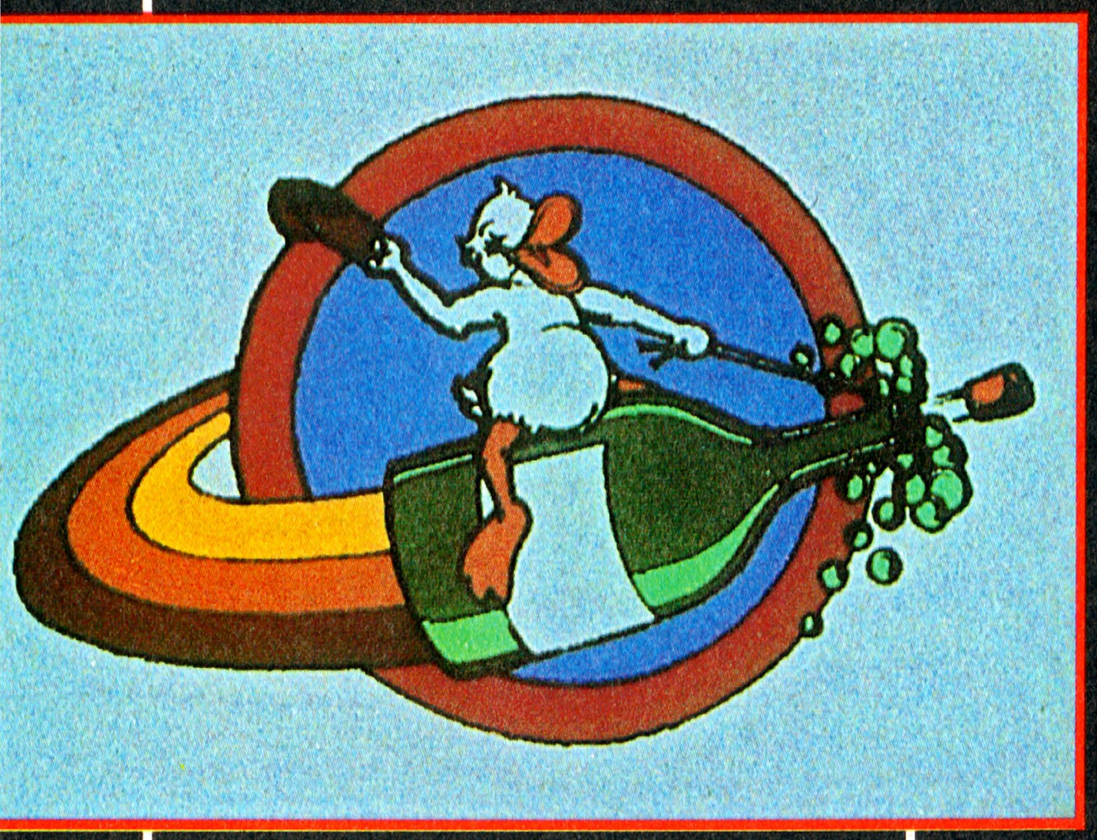

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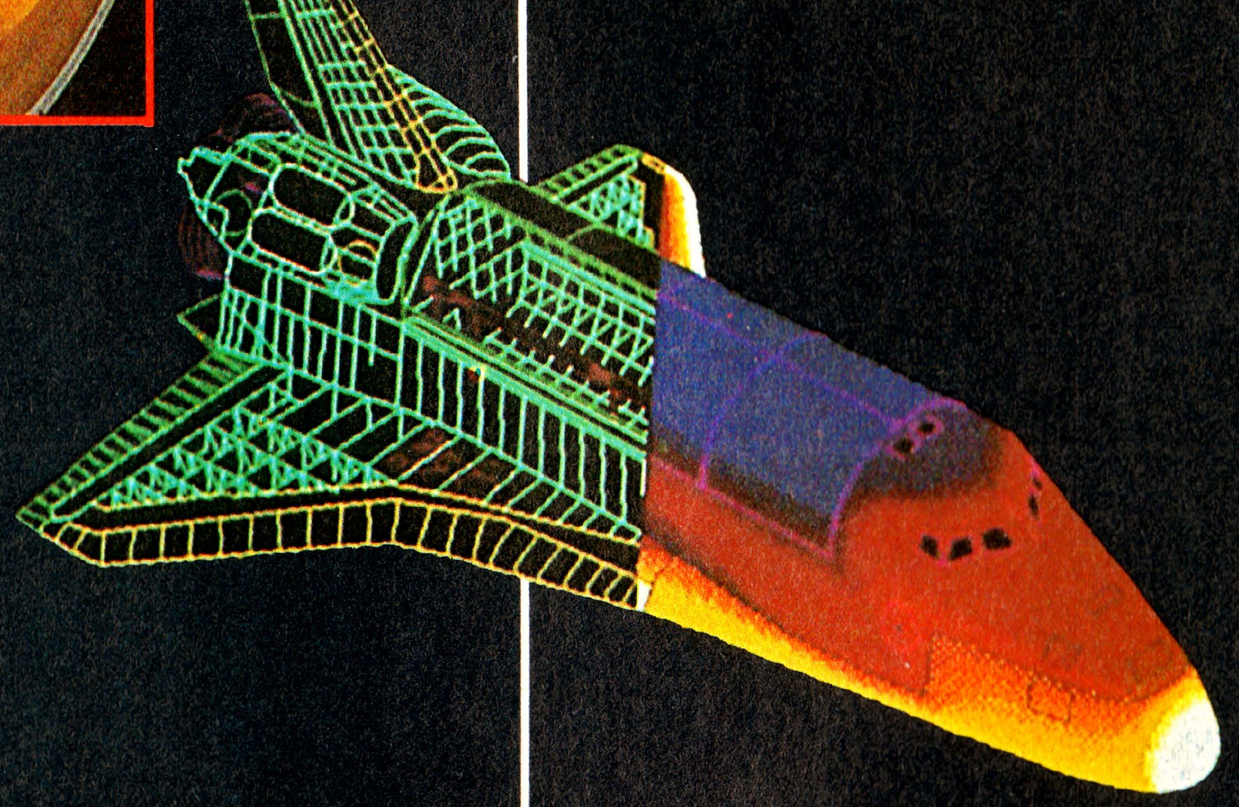

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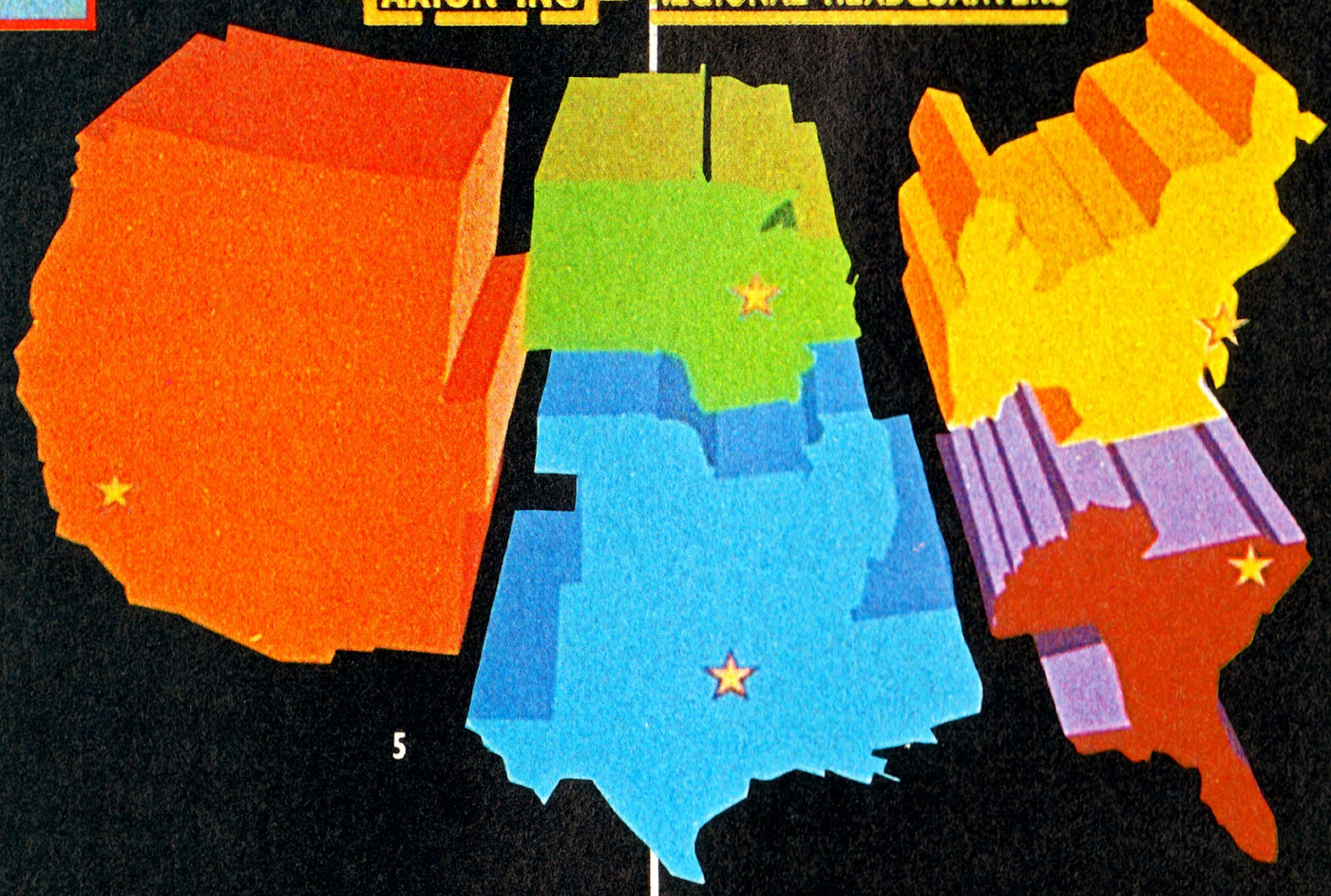

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Although few people realize it, the hyperspace-drive special effects in *Star Wars*, the aliens in the popular Space Invaders arcade game, and the local television station's spinning logo are all examples of computer-generated animation and graphics. Such high-tech art forms have been delighting our eyes for a decade.

Prior to 1970, computer graphics were used primarily in scientific research, and then only occasionally. But in the last decade the field has literally exploded with new technology, a wide range of applications, and a sophistication matched only by viewer expectations. Outside of the entertainment field, space-flight simulations, biological experimentation, and even car design have benefited from the union of computer programmer and artist.

The state-of-the-art technology in computer graphics was the subject of the annual SIGGRAPH (Special Interest Group on Computer Graphics) conference held in Dallas late last summer. A splinter group of the Association for Computing Machinery, SIGGRAPH drew more than 11,000

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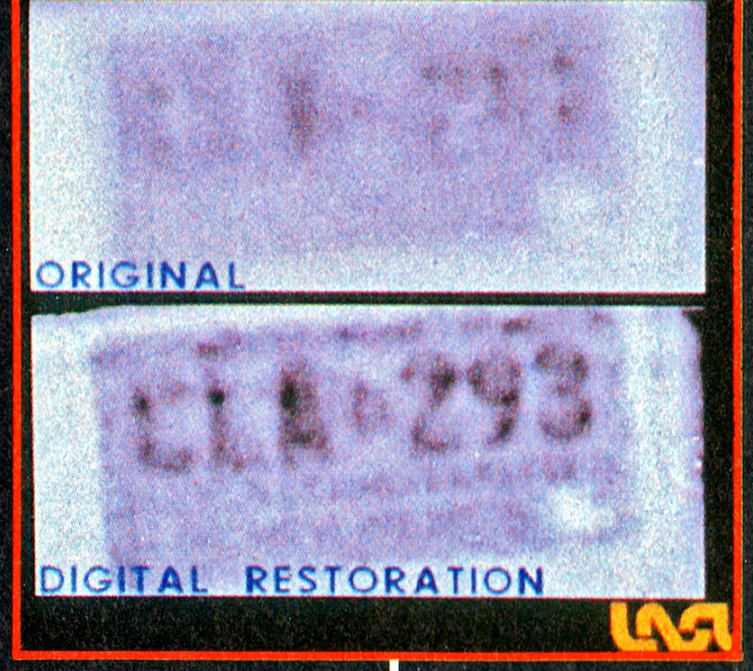

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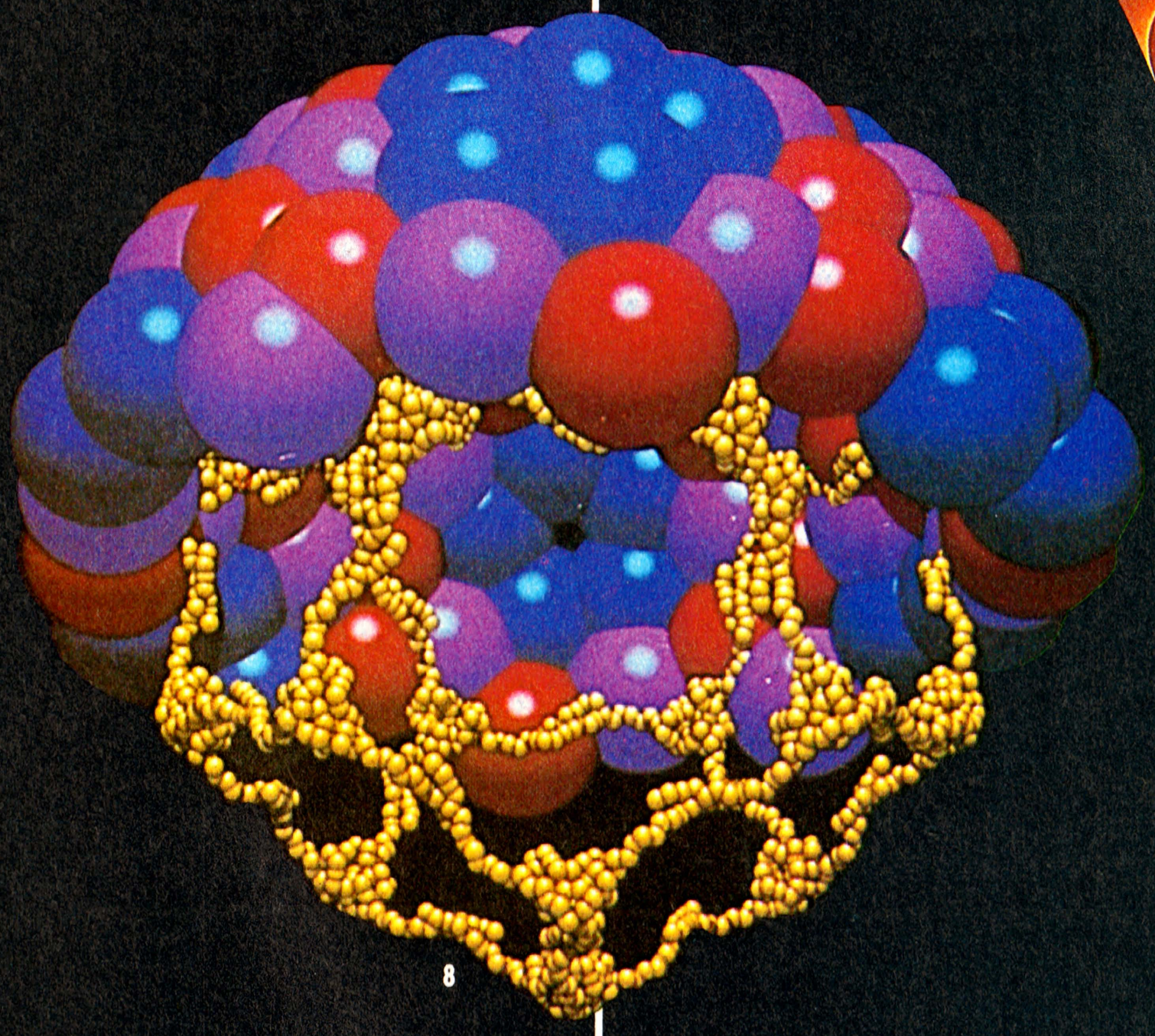

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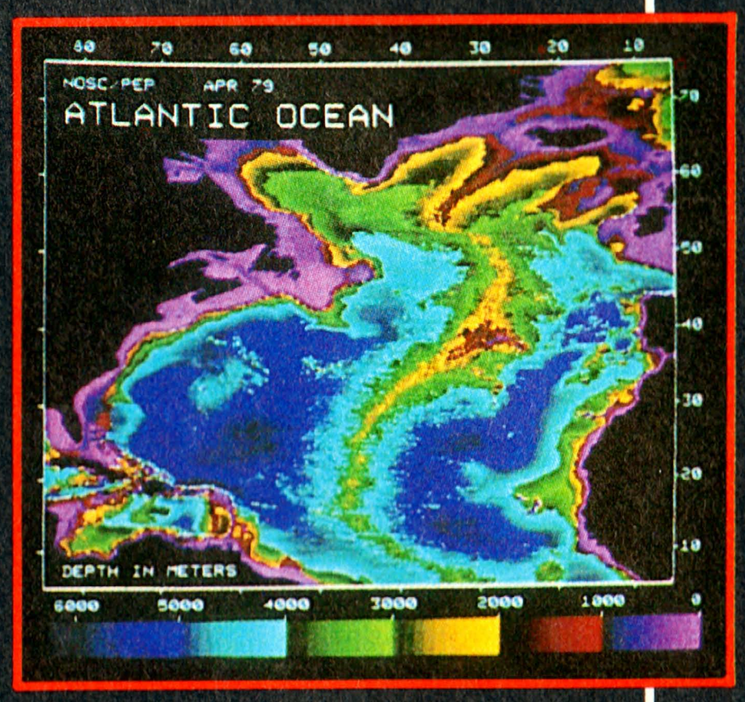

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people interested in human-machine interaction, computer art, animation, graphics, software and hardware, and computer-aided design.

And what is the state of the art? The photographs shown here are just a taste of what's going on.

Photograph 1 is an example of stress analysis of a steel cylinder bending over a rail, by Bruce Eric Brown of the Lawrence Livermore National Laboratory.

Photograph 2 is a logo design for a softball-team T-shirt by Dick Shoup of Aurora Imaging Systems, Belmont, California.

Photograph 3 is a model of a carafe with an image of a ship placed over it electronically. The shadow is created by a light source placed at the top of the carafe. The illustration is from Rensselaer Polytechnic Institute, Image Processing Lab, by Michael Potmesil.

Photograph 4 is a space-shuttle design created by C. Cantwell, H. P. Dunn, and J. Dunn, of Dunn Instruments. This is the type of work mechanical engineers and designers can produce on a computer.

Photograph 5 is an example of business graphics generated by Dicomed Corporation.

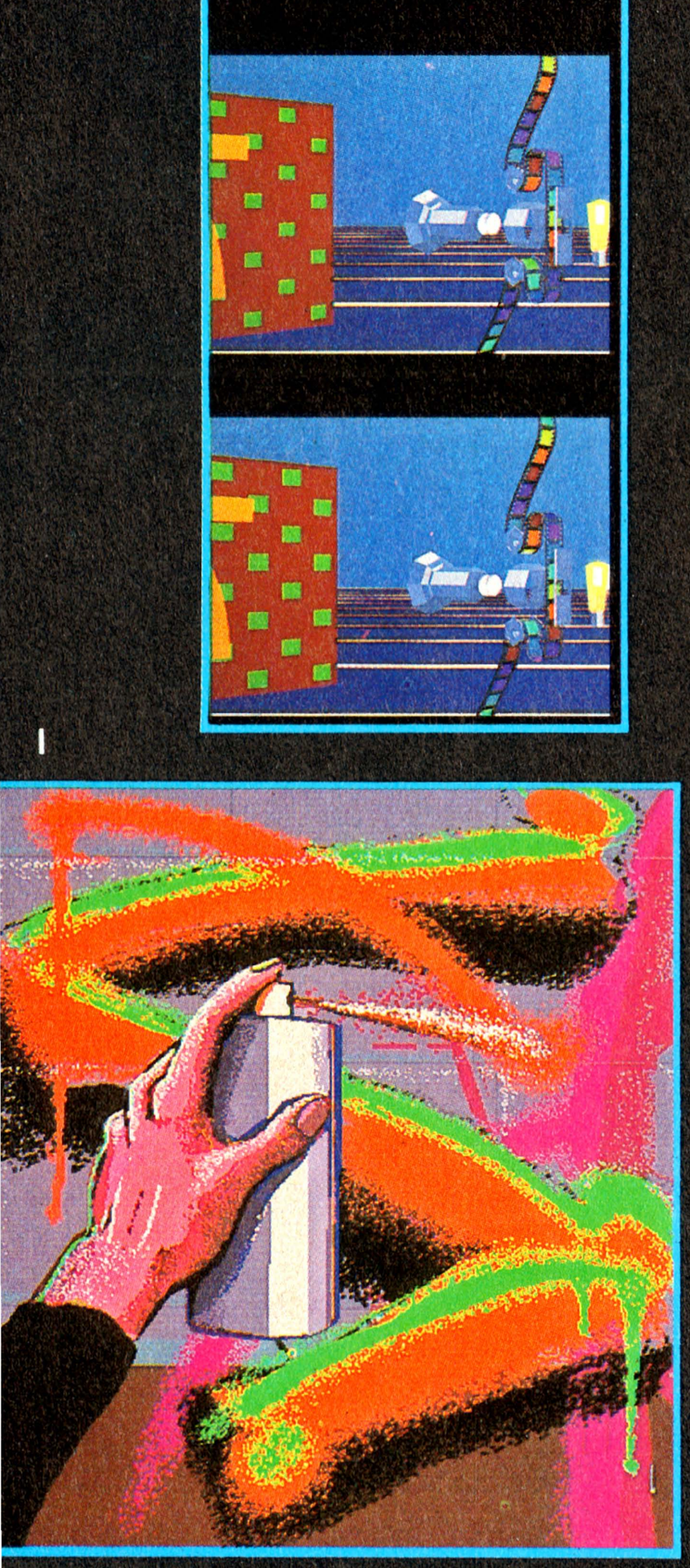
Photograph 6 is an out-of-focus photo of a license plate, which has been restored by a computer to make the numbers legible. The photo is by T. M. Cannon and H. J. Trussell.

Photograph 7 is an abstract art design plotted by a computer using a mathematical calculation. The illustration is by M. Prueitt.

Photograph 8 is a representation of proteins from a virus, by Nelson Max of the Lawrence Livermore National Laboratory.

Photograph 9, by Larry McCleary of the Naval Ocean Systems Center, is an example of computer representation of data from the Atlantic Ocean.

Photograph 10 is a terrain simulation by Loren C. Carpenter of Boeing Corporation. Such films are used in flight simulation.



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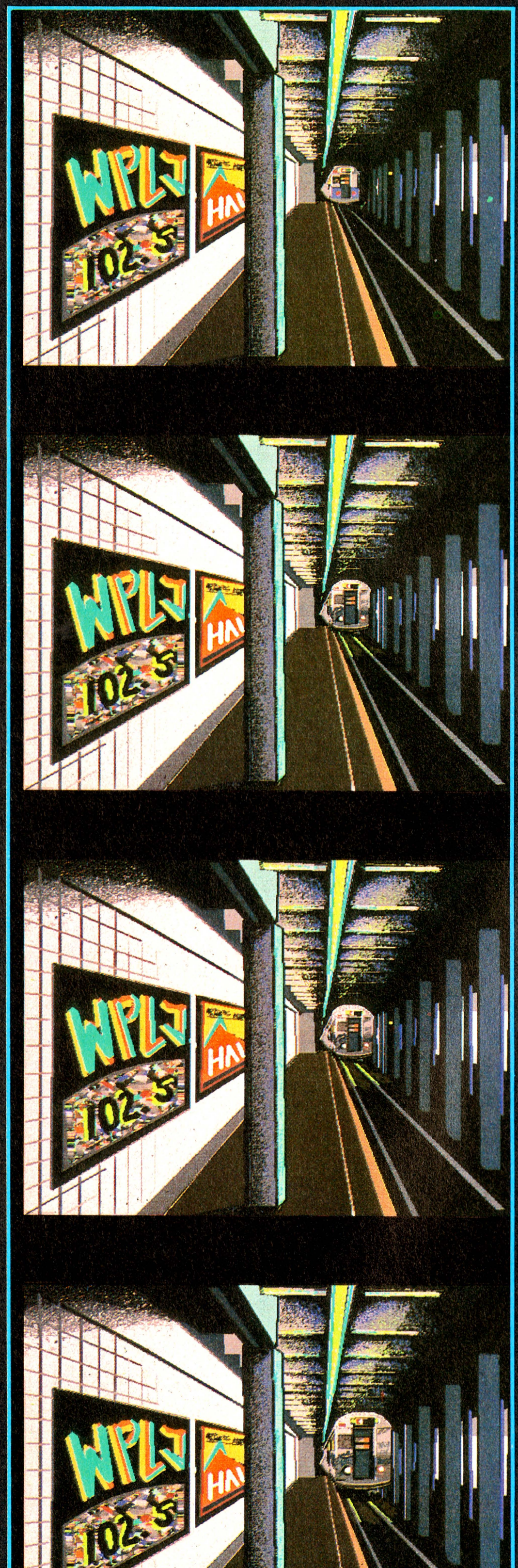

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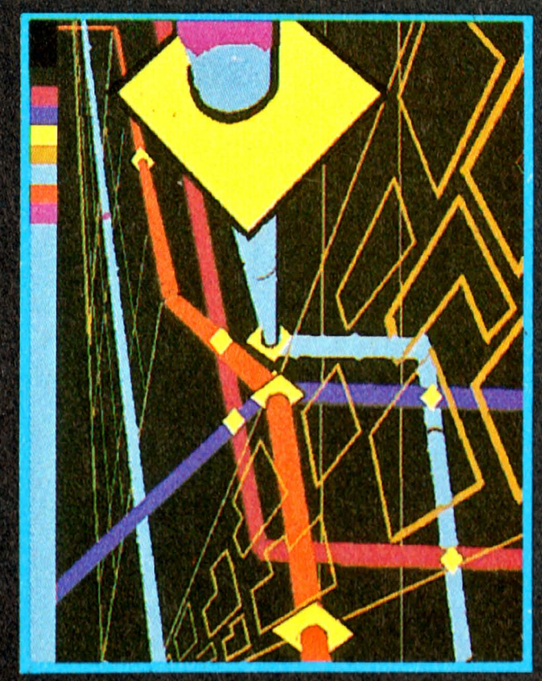

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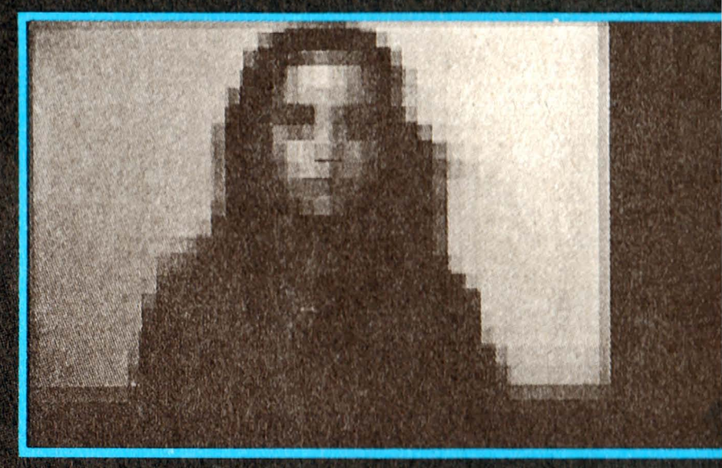

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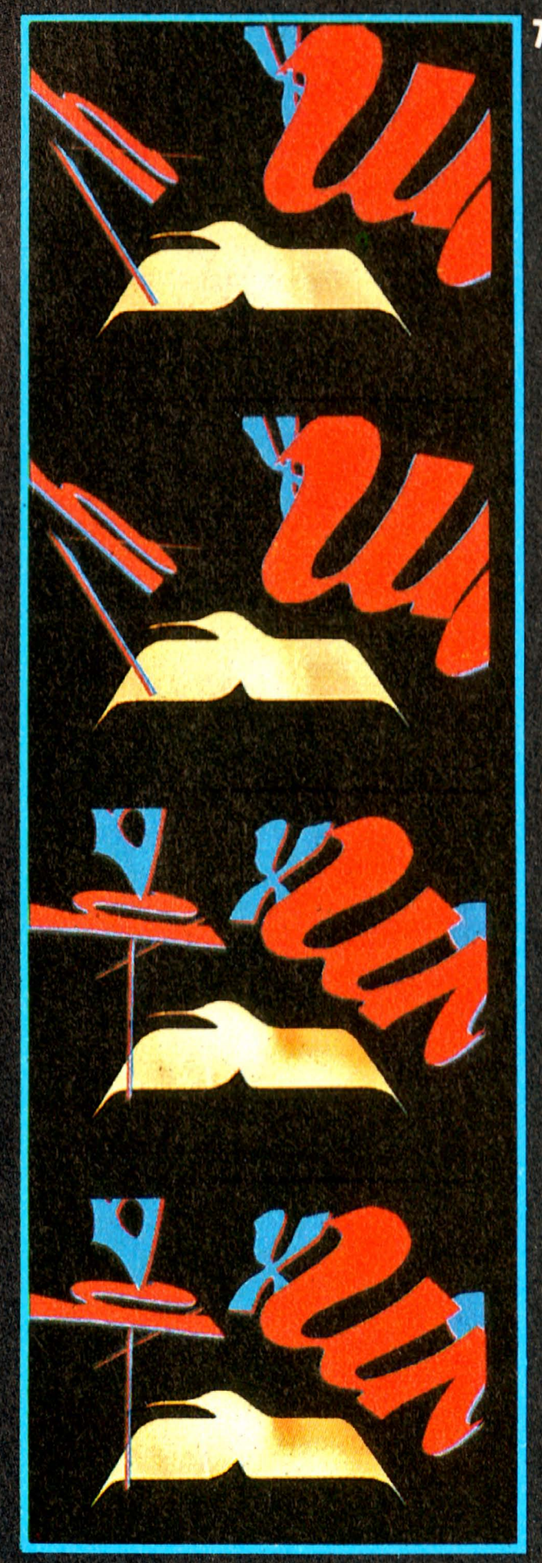

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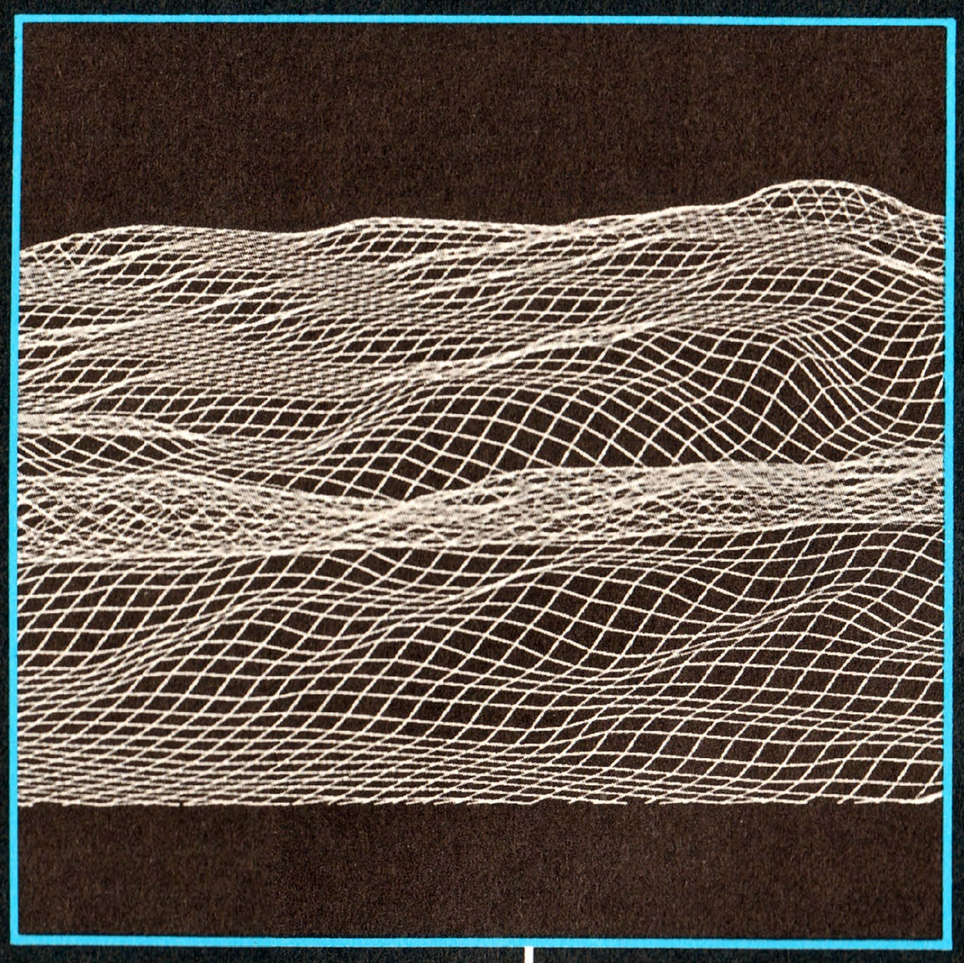

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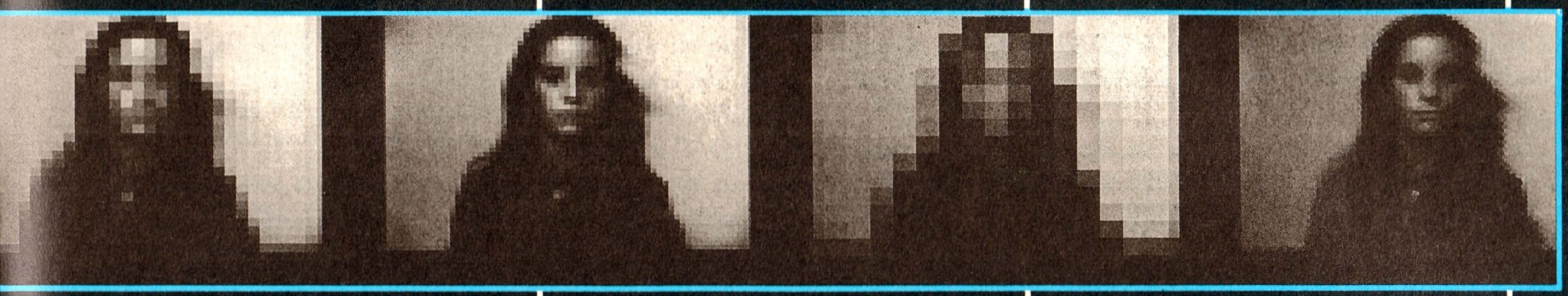


"Computer graphics is a major media art form, not just a fad," says Judson Rosebush. "People are going to read about it, they're going to understand it, and before long, they're going to do it on their Apples." That's a tall order for the personal computer, given the complexity and elegance of the illustrations shown here.

But Rosebush ought to know what the future holds for computer art. He's president of Digital Effects, Inc. (DEI), a Manhattan-based design firm that's considered the new industry's front-runner. DEI is also the developer of the Video Palette II system, a graphics-generating computer system that uses digital information to create high-tech animation. While the firm considers itself primarily a design company, its clients include advertising agencies, major consumer corporations, television networks, science and medical groups, and motion-picture producers.

DEI techno-artist Mark Linquist, who specializes in animation, explains what makes computer animation a revolution in the field. "Animators used to paint on 'cels,' pieces of film that made up frames that went through the motion camera. Each cel equaled one frame, and 24 frames went through the camera each second. Considering the cels were painted by hand, you're talking about a tremendous amount of work at an exorbitant cost. With computer animation, you don't have to paint by hand. You illustrate and the computer moves you from point A to Z." Where a typical Walt Disney film once required a five-to-eight-year production schedule, sophisticated computer-animation films can now be produced in weeks.■

Photographs 1 through 4 are from the computer-animated film *Subway* by Mark Linquist. Photograph 1 is a painting produced on a digitizing tablet, which takes an artist's work and translates it into data a computer can understand. Photographs 2 and 3 highlight the ability of the computer to move one or more elements (the train and the film strip) through space, while holding the other parts of the picture steady. In photograph 4, the red dot on the upper left-hand side of the picture can be moved and turned on and off as it makes its way through the pipe.

Photograph 5 is a sample of vector-graphics plotting, which is used for a variety of purposes such as geographical mapping and graphic representation of mathematical data.

Photograph 6 is a sample of "block pixing," a technique in which pixels (small points on a computer display screen) are analyzed and enlarged by a computer. The technique was created at Bell Laboratories more than 20 years ago, but was not used until the advertising industry caught sight of it. The rippling effect of block-pixing animated film sequences has proven its appeal to viewers in a number of television commercials.

Photograph 7 is an example of computer manipulation of objects moving at different speeds in different directions.

Photographs on these pages courtesy of Digital Effects, Inc.

My Computer Likes Me

by George Firedrake and Ramon Zamora

This series is designed for parents and teachers who want to help children learn how to use computers. (It's also a good introduction for adults who want to learn about computers.)

Last month we learned how to do some elementary BASIC programming on the Radio Shack TRS-80 Color Computer. This month, let's take a look at a few intermediate ways of generating music, as well as generating random numbers, which you need for many types of programs.

So get out your Color Computer, hook it up, and let's get going.

More Sound for Less Work

Use READ and DATA statements to get more sound for less work.

```
100 REM ** READ-DATA MUSIC #1
110 CLS

200 REM ** READ AND PLAY ONE NOTE
210 READ T
220 SOUND T, 10

300 REM ** GO PLAY ANOTHER
310 GOTO 210

900 REM ** TONE NUMBERS
910 DATA 89, 108, 125, 133, 147
920 DATA 159, 170, 176
```

RUN the program and sing along: do, re, mi, fa, sol, la, ti, do. Play and sing for awhile, then replace lines 910 and 920 with the following:

```
910 DATA 176, 170, 159, 147, 133
920 DATA 125, 108, 89
```

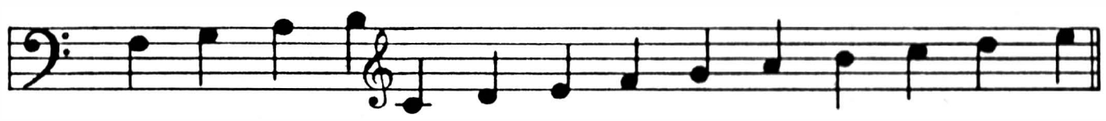
George Firedrake (alter ego of Bob Albrecht) and Ramon Zamora are regular columnists for Popular Computing.

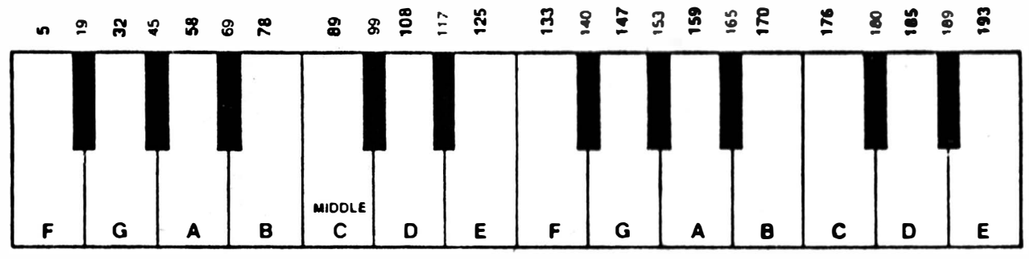
One, two, three—do, ti, la, sol, fa, mi, re, do.

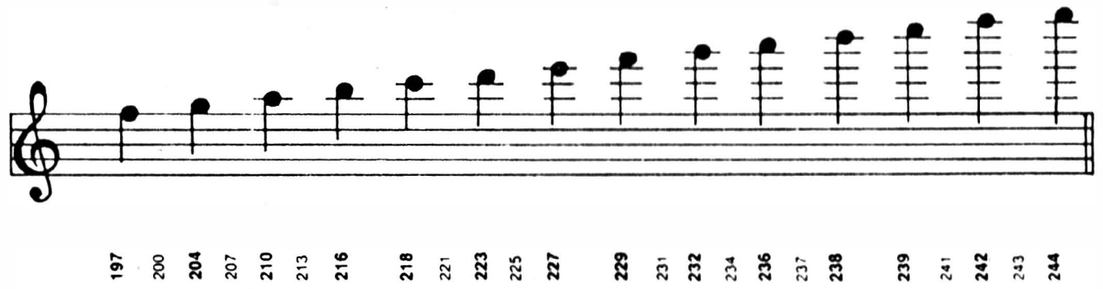
Voices all warmed up? Good. Let's try some real music.

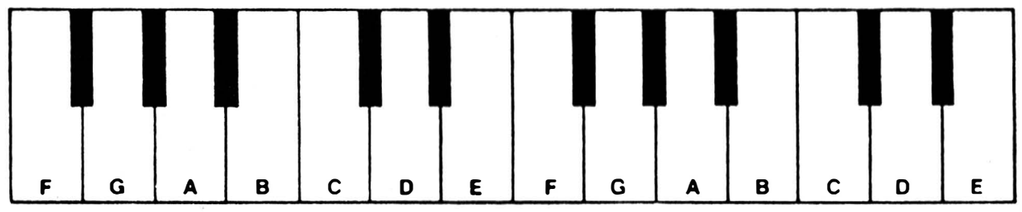
```
910 DATA 125, 108, 89, 108
920 DATA 125, 125, 125, 108
930 DATA 108, 108, 125, 147, 147
```

Here are some helpful diagrams for pianists and other people who can read music:









Here is a program to help you practice your 12-tone scales.

```
100 REM ** READ-DATA MUSIC #2

200 REM ** READ TONE NUMBER AND NOTE
210 READ T, N$

300 REM ** DISPLAY IT AND PLAY IT
```

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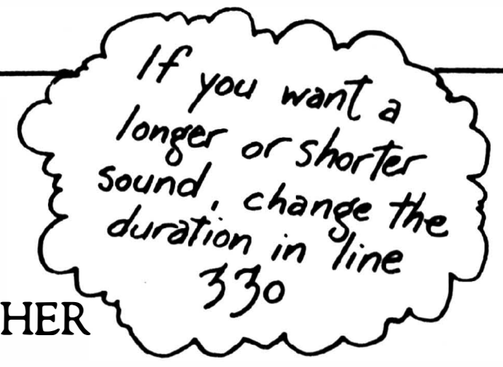



```
310 CLS
320 PRINT @239, N$;
330 SOUND T, 10

400 REM ** GO PLAY ANOTHER
410 GOTO 210

900 REM ** TONE NUMBERS AND NOTES
910 DATA 89, C, 99, C#, 108, D, 117, D#
920 DATA 125, E, 133, F, 140, F#, 147, G
930 DATA 153, G#, 159, A, 165, A#, 170, B
940 DATA 176, C
```

Oh, you want to go *down* the scale? Easy, except for one thing. There is no flat symbol (♭) on the keyboard. So we will use an exclamation point instead. B! means B♭.

```
910 DATA 176, C, 170, B, 165, B!, 159, A
920 DATA 153, A!, 147, G, 140, G!, 133, F
930 DATA 125, E, 117, E!, 108, D, 99, D!
940 DATA 89, C
```

When you RUN the program, the note appears on the screen, near the center. Then you hear the tone. Try replacing lines 320 and 330 with the following:

```
320 SOUND T, 10
330 PRINT @ 239, N$
340 FOR K=1 TO 250: NEXT K
```

Now you will hear the tone while watching a blank screen. When the tone stops, the note appears. Did you guess correctly? Pretty easy when doing scales! So scramble the data—use the tone numbers and notes out of sequence.

The music our programs play is fairly uninteresting: all tones have the same duration. We suggest that you rewrite them so the computer reads tone number *and* duration for each note.

READ T, D or READ T, N$, D

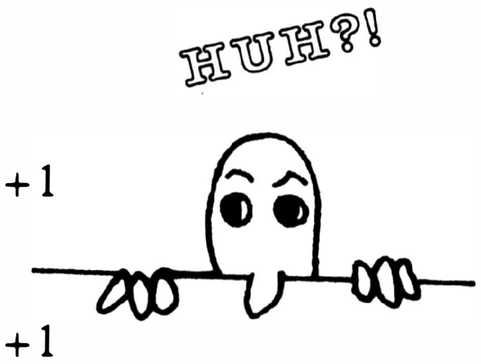
Hmm . . . you could use D=1 as a sixteenth note. Then D=2 is an eighth note, D=4 is a quarter note, D=8 is a half note, and D=16 is a whole note. The following table shows the equivalent durations in hundredths of a second.

D	TIME (seconds)	
1	6/100	
2	12/100	
4	24/100	
8	48/100	(about half a second)
16	96/100	(almost one second)

Play, maestro, play!

Meandering

One of the nicest things about Radio Shack computers is the way the RND function works. It gives integer random numbers in a way that is easy to understand and use. Most other computers give a messy-looking random number between 0 and 1, such as 0.637492 or 0.225083. We really can't understand why—most applications (especially games) require integer random numbers. In most BASICs, a lot of mind-boggling math is required to get the desired integer random numbers.



Desired random numbers: 1 or 2
- TRS-80: RND(2)
- Most others: INT(2*RND(1))+1

Desired random numbers: 1, 2 or 3
- TRS-80: RND(3)
- Most others: INT(3*RND(1))+1

Desired random numbers: 1, 2, 3, 4, 5, 6
- TRS-80: RND(6)
- Most others: INT(6*RND(1))+1

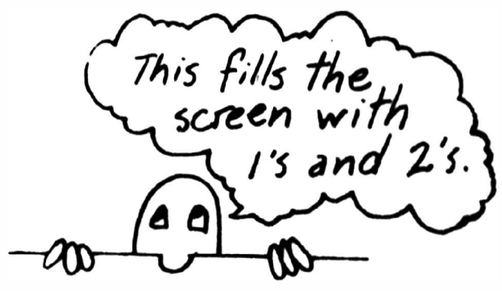
Desired random numbers: 0, 1, 2, 3, 4, 5, 6, 7, 8, 9
- TRS-80: RND(10)–1
- Most others: INT(10*RND(1))

Desired random numbers: 1 to 100
- TRS-80: RND(100)
- Most others: INT(100*RND(1))–1

Got the idea? It goes like this. If *n* is a positive integer, then RND (*n*) gives random positive integers in the range 1 to *n*. It's simple and neat.

Bonus! RND(0) gives random numbers in the range 0 to 1, just like all the other computers. Radio Shack gives you the best of both worlds.

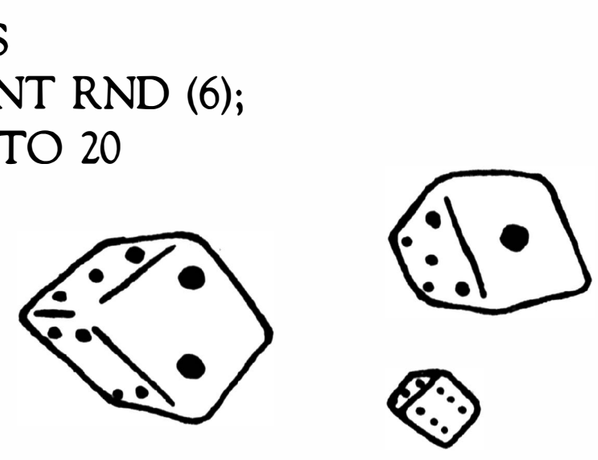
IMPORTANT NOTICE! Remember, this series is about teaching BASIC to kids. So, the RND function is one of the most important elements of BASIC. It is one of the things that makes BASIC fun. For ease in teaching, use the integer RND function.




```
10 CLS
20 PRINT RND (2);
30 GOTO 20
```

```
10 CLS
20 PRINT RND(3);
30 GOTO 20
```

```
10 CLS
20 PRINT RND (6);
30 GOTO 20
```



```
10 CLS
20 PRINT RND(10)-1;
30 GOTO 20
```

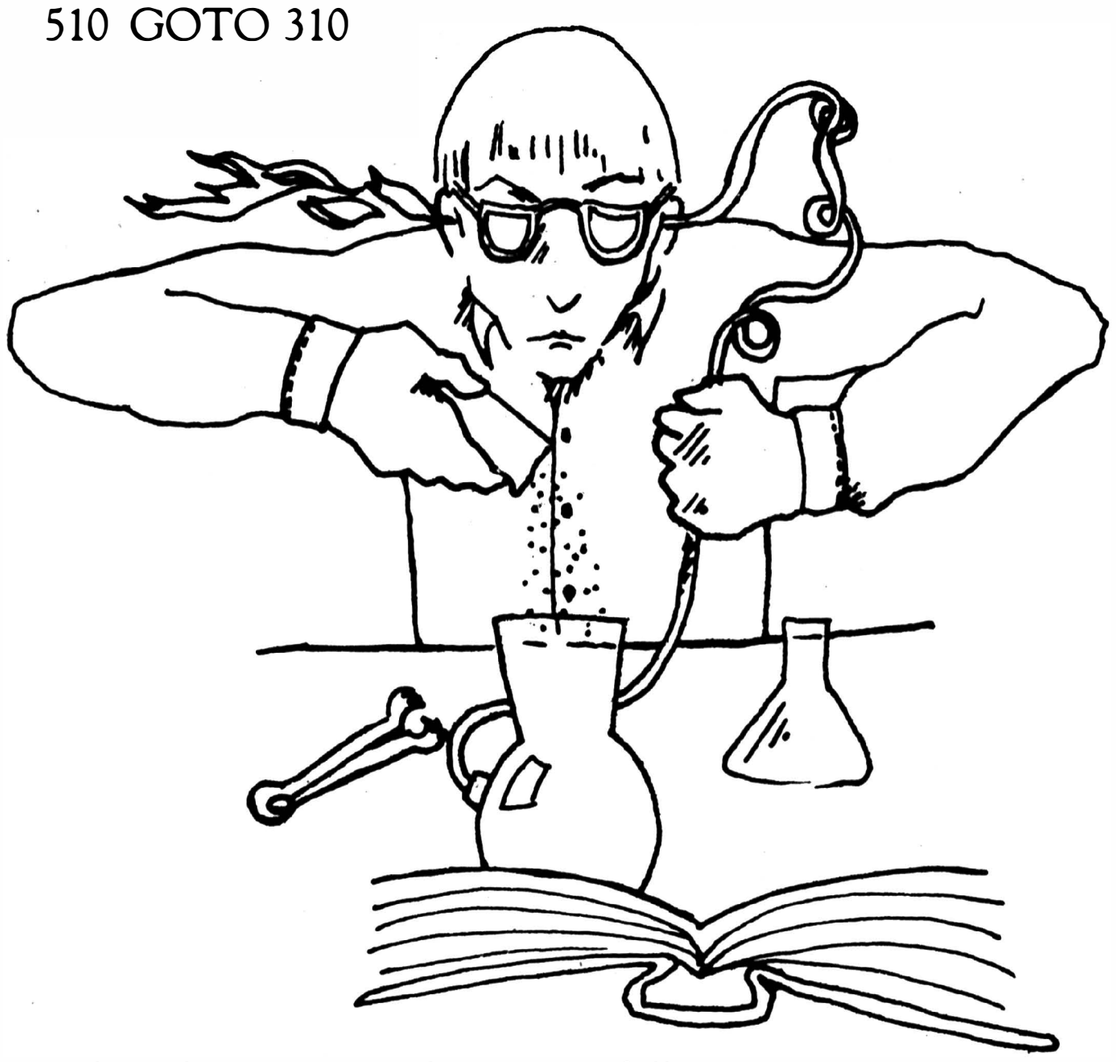
So RND gives random numbers. So what? Well, let's use them to put a name here, there, or anywhere on the screen.

Here for a moment, there for a moment, somewhere else for a moment.

```
100 REM ** SKITTERY NAME
200 REM ** ASK FOR NAME
210 CLS
220 INPUT "WHAT IS YOUR NAME";N$
300 REM ** SHOW NAME HERE, THERE,
    ANYWHERE
310 CLS
320 SP = RND(511)
330 PRINT @SP, N$;

400 REM ** TIME DELAY
410 Z = 100
420 FOR K = 1 TO Z: NEXT K

500 REM ** GO DO IT AGAIN
510 GOTO 310
```



Explain lines 320 and 330 carefully. Line 320 computes a random integer from 1 to 511 and puts this number in box SP (screen position). Line 330 prints the value of N$ at print position SP.

Lines 410 and 420 are a time delay. Change line 410 to make things happen faster or slower.

Faster: Make Z < 100
Slower: Make Z > 100

As usual, slowly and patiently explain what is happening. If you're met by "What if . . .?" then say, "Try it and find out!"

In the spirit of experimentation, change line 510 to:

```
510 GOTO 320
```

Now RUN the program to find out what happens.

Awful Music

Hey kids! Want to drive your parents crazy? RUN this program.

```
100 REM ** RANDOM MUSIC
110 CLS

200 REM ** PICK A TONE AND PLAY IT
210 T = RND(255)
220 SOUND T, 1

300 REM ** GO PLAY ANOTHER
310 GOTO 210
```

To eliminate those scratchy high notes, change line 210, as follows:

```
210 T = RND(218)
```

← or try another number here

How about random duration? Make these changes.

```
210 T = RND(218)
220 D = RND(4)
230 SOUND T, D
```

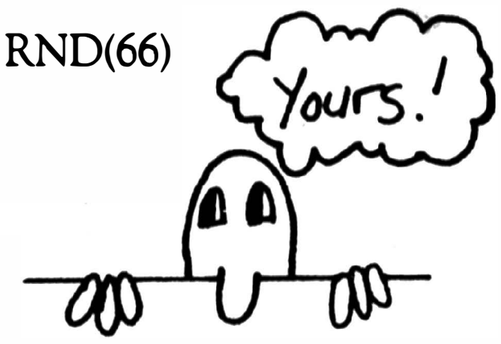
While we are adding things, let's put in some random color.

```
210 T = RND(218)
220 D = RND(4)
230 C = RND(8)
240 CLS C
250 SOUND T, D
```

Ah. That's it! Enter the program and run it. Relax, sit back—watch and listen—it's like watching prime-time TV.

Experiment! Try some of these changes.

```
210 T = 10*RND(20)
210 T = 88 + RND(88)
210 T = RND(100) = RND(100)
210 T = RND(66) + RND(66) = RND(66)
210 T = 15*(RND(6) + RND(6))
210 T = RND(RND(200))
210 T = 201 - RND(RND(200))
210 T = _____
```



Future Play

This material is intended for use as an outline for parents or teachers on how to help kids learn to use, program, and enjoy computers. These ideas are best used when a kid asks, "How does the computer do that?" or "How can I make the computer do what I want it to do? " or "Can the computer tell me (whatever)?" or . . . .

So you have a computer and the kids have played Hurkle, Taipan, Adventure, Taxman, Invasion Force, and countless other games. Now they want to know more; they want to write game-playing programs or they want to put interesting visual patterns on the screen. And why not? They control the future, so let them control the computer, the tool of the future. Let them shape it in ways unknown to us. Then stand back and enjoy. And be prepared to be surprised.

Help!

What would you like to see in "My Computer Likes Me"? Send requests to George and Ramon, POB 310, Menlo Park CA 94025. If you want a reply, enclose a self-addressed stamped envelope. If you like this stuff, please tell us. If you don't like it . . . (sigh) . . . we need to know that too. Help us improve by being specific and constructive. See you next month. ■

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DragonSmoke

DragonSmoke is written for people who want to help children learn to use, program, and enjoy computers. We point to resources and sources of information we have found to be useful, entertaining, or inspirational in our use of the Atari 400, the Commodore PET and VIC-20, and the Radio Shack TRS-80 Model I, Model III, and Color Computer.

The information presented in DragonSmoke is subjective, highly opinionated, and definitely *not* supported by scholarly research. It is based on 19 years of personal experience in using computers with thousands of youngsters (ages 8 to 13) and teachers (ages 8 and up).

Instead of School

Your home computer is a powerful aid to learning, and there are thousands of programs to help your child (or you) learn almost anything. A home, a friend's home, or a neighborhood can be a learning center. If you are interested in teaching kids at home as an alternative to public school, try the following sources of information, reprinted with permission from *The Next Whole Earth Catalog* (copyright © 1980 by POINT, POB 428, Sausalito CA 94966; $16 postpaid).

School at Home

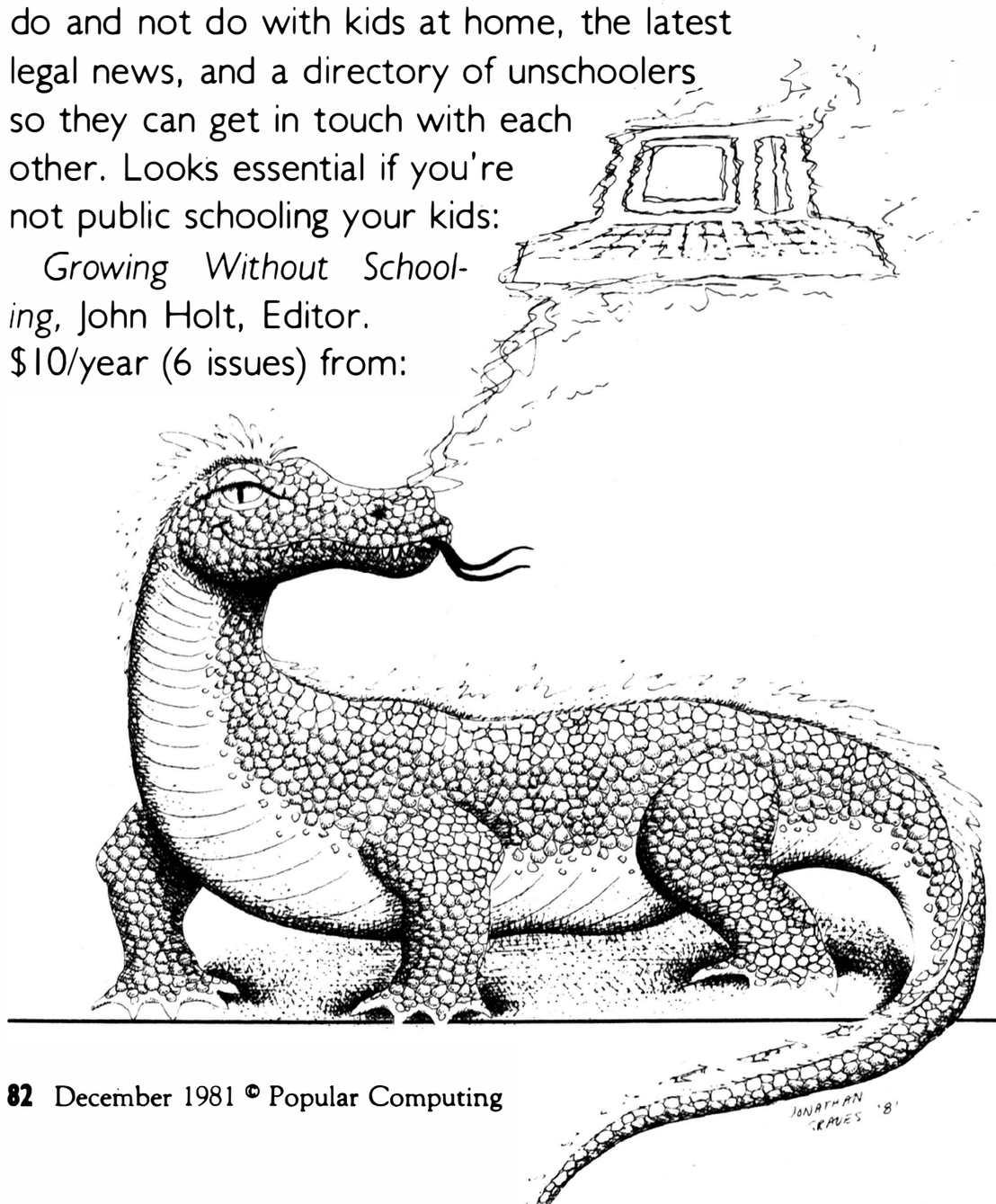
Encouragement and experienced advice on home teaching, including coverage of home study courses by mail and sundry state laws about compulsory school attendance:

School at Home (An Alternative to the Public School System), Darcy Williamson, 1979, 91 pages. $9.95 postpaid from: Maverick Publications, P.O. Drawer 5007, Bend OR 97701; or, Whole Earth Household Store, Building D, Fort Mason Center, San Francisco CA 94123.

Growing Without Schooling

John Holt's newletter about not sending children to school. Letters from people who are doing it, advice about what to do and not do with kids at home, the latest legal news, and a directory of unschoolers so they can get in touch with each other. Looks essential if you're not public schooling your kids:

Growing Without Schooling, John Holt, Editor. $10/year (6 issues) from: Growing Without Schooling, Holt Associates, 308 Boylston St., Boston MA 02116.



Good Software. . .Where?

How do you find out about the thousands of programs for home computers? More important, how do you decide which ones to buy? Try some software-review publications.

**Purser's Magazine*, POB 466, El Dorado CA 95623. Issue #12 costs $4, plus $2 postage and handling. Or ask for it at your local computer store.

The best software-review publication—entertaining, outrageous, and downright useful. Issue #12 has 96 pages full of good stuff for users of Apple II and Radio Shack computers, including "A Guide to Computers" (wonderfully opinionated), "Seven Reasons to Buy a Computer" (excellent), software reviews (25 Apple, 47 TRS-80), addresses of program publishers, and software directories.

Purser's is worth reading just for fun, even if you don't buy any software. Ask about back issues—get them if they're available.

**Atari Software Reviews, Articles, Etc.*, POB 466, El Dorado CA 95623. Summer 1981 issue available for $1, plus $2 postage and handling. Or look for it at your computer store.

This is a special edition of *Purser's Magazine*. 48 pages of information and reviews for users of Atari 400 and 800. Includes reviews of 44 programs, mostly educational and recreational.

**Software Critic*, POB 3CH, University Park NM 88003. $15/year (6 issues).

This new periodical (first issue May-June 1981) reviews software for Radio Shack TRS-80s. Issue #1 has 22 pages with ten reviews plus other information.

For People Who Like People

Here is a great place to find computer pen pals:

The Community Computerist's Directory, POB 405, Forestville CA 95436, $10/year (4 issues).

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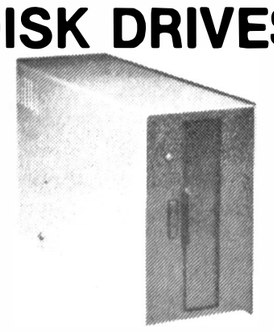

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Printers: Why You Need One, How to Choose One

by George Stewart

The printed word is a tangible, dependable form of information. Once you have it on paper, you can do a great deal with the information—study it and make corrections, show it to another person, or put it aside with no reason to doubt that you'll be able to retrieve it next week or next year.

The printed word also has character. You can feel its texture and weight. Newsprint, bond, computer printout, slick magazine stock . . . the paper itself contributes to the idea conveyed. After several persons have read a paper, it acquires a history of handwritten comments, creases, thumbprints, etc. ("Hmmm. Robert was eating cinnamon toast while he read this.")

And the printed word has authority. Ideas, agreements, calculations, descriptions, when printed, become *documents*. Printed words will not rearrange themselves, change meaning, or dissolve into gibberish. (This cannot always be said for oral information or information stored inside a computer.) The printed word is like hard currency.

Yes, you need a printer for your computer system. To state the case practically, a printer gives you the following benefits:

- Program listings and data reports are easier to read on paper than on display screens.
- Having hard copy protects you against the loss of programs or data due to equipment failures and power outages.
- Communications between people are more effective when printed than when displayed on a computer screen.
- Some uses—like printing payroll checks—require a printer.

Of course you need a printer!

George Stewart is a technical editor for Popular Computing.

The differences between printers are significant—perhaps more so than the differences between computers.

If you still need convincing, talk to someone who has done *without* a printer. These deprived computerists are easy to spot: bloodshot eyes, stiff necks, cuffs and shirttails covered with scribbled program line numbers, page references, file names, and other details to be remembered when no printer is available.

Choosing a Printer

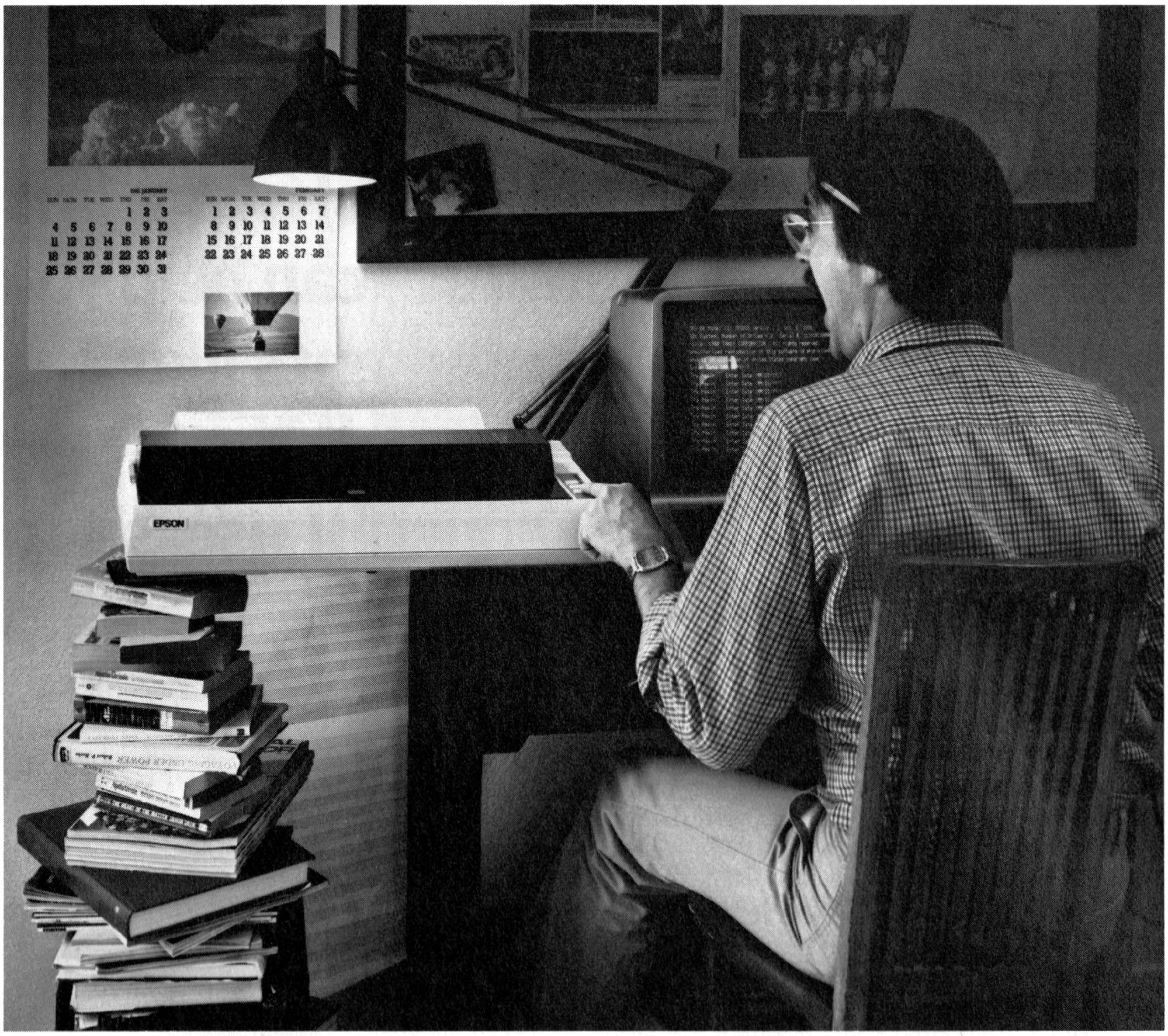
Choose a printer carefully. The differences between printers *are* significant—perhaps more so than the differences between computers. Software can mask differences between computers, but not between printers. Think of it this way: in selecting a printer, you are choosing a set of limitations. Sound negative? Well, nobody has yet invented the universal, all-purpose, unlimited printer. And if someone does, who'll be able to afford it? So choose your limitations carefully.

What's important to you? Decide on your top priority first. Is it:

- letter-quality printing
- greatest speed
- lowest cost for hard copy in any form
- special capabilities like graphics or plotting

There's a definite trade-off between speed and quality of printing. Some manufacturers have dealt with this limitation by incorporating two modes into a single printer: one creates well-defined characters but is relatively slow; the other is much faster but less readable and appealing.

If you plan to use your printer for word processing—business letters, reports, manuscripts, newsletters, and other reading matter—quality of printing should be a top priority. This also holds true if you are creating camera-ready copy for reproduction.



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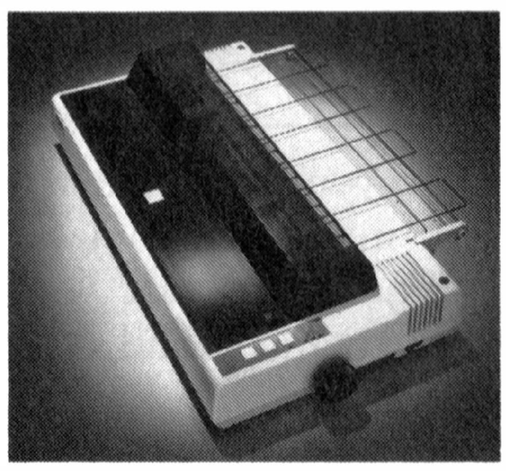
Needless to say, the specs on this machine — and especially at under $1000 — are practically unbelievable. But there's something about the MX-100 that goes far beyond just the specs; something about the way it all comes together, the attention to detail, the fit, the feel. Mere words fail us. But when you see an MX-100, you'll know what we mean.

All in all, the MX-100 is the most remarkable printer we've ever built. Which creates rather a large problem for those of us at Epson.

How are we going to top this?



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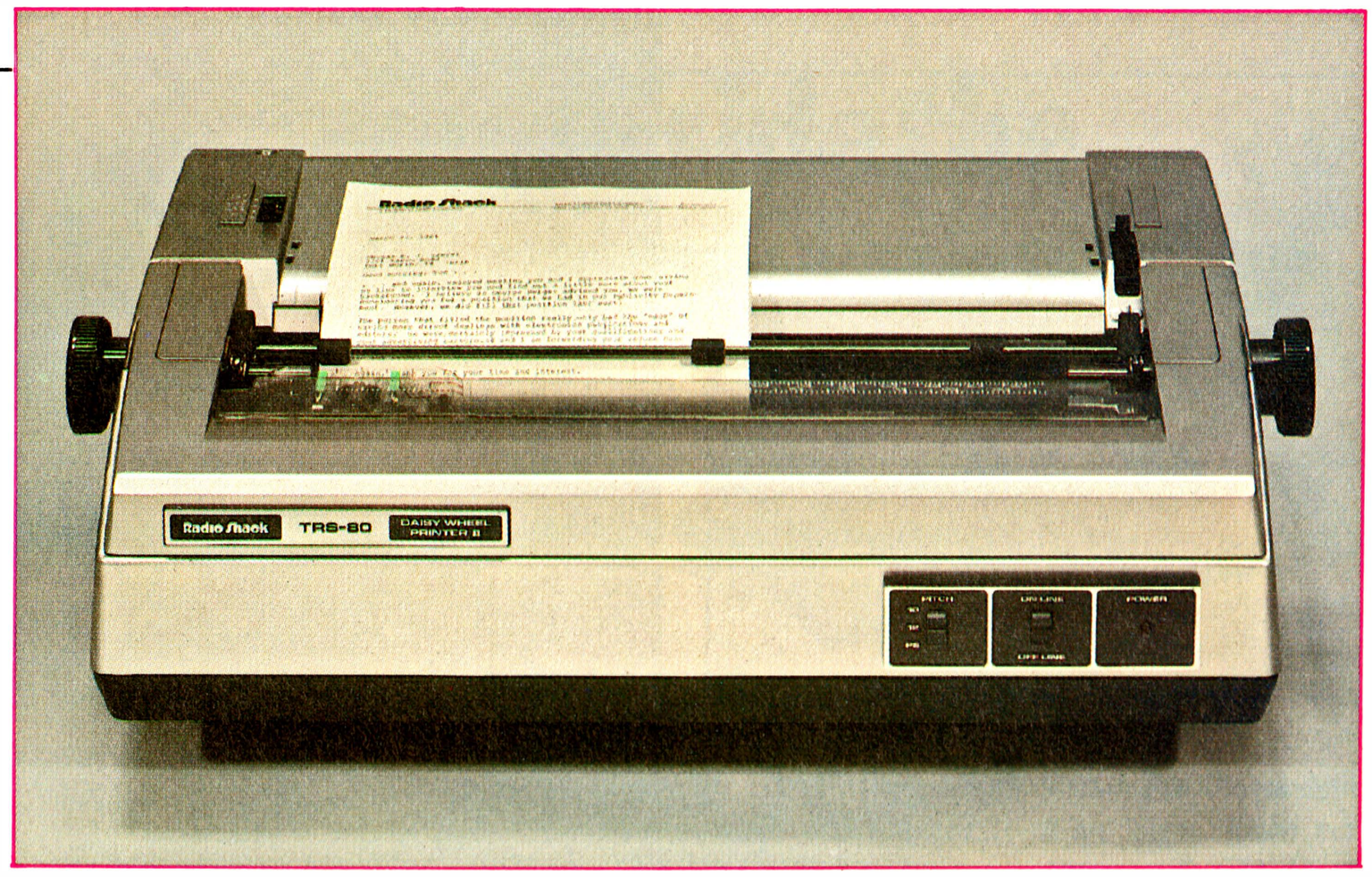
If your printer will be used for data processing—lengthy accounting documents, inventories, program listings, and other high-volume material—you should get the fastest printer you can afford. You don't want to spend much time waiting for your computer to finish a printing job so you can continue with your work.

If you're going to use the printer for your own convenience—record keeping, program development, and informal word processing—cost should be the primary factor. Last, if you have a special application, it may preempt all other considerations.

After you've established priorities, you're ready to start looking at printers.



Daisy-wheel printers provide the best-quality printing for correspondence and word processing (Radio Shack Daisy Wheel II).

What Kind Is It?

There are two key questions to ask when looking at printers:

- Does it print dot-matrix or fully formed characters?
- Does it use plain or special paper?

Dot-matrix characters are made up of dots (surprised?). The amount of detail in each character is limited by the density of the matrix used. (See text box below for further explanation.) *Fully formed characters*, on the other hand, consist of solid lines. The characters in this article are fully formed.

Most *plain-paper printers* transfer characters onto the page by striking an ink ribbon against the paper, or vice versa; for this reason, they're called *impact printers*. *Special-paper printers* use other means (heat, electrical current, or chemical action).

In this article, we're going to discuss printers that are affordable, available, and intended for use with personal computers—the kind you'll find at computer stores. We're not going to discuss printers that cost more than $2000, retrofits for office typewriters, build-it-yourself printers, laser printers, or ink-jet printers. Some of these excluded units may be interesting to read about, but we're trying to be *practical*.

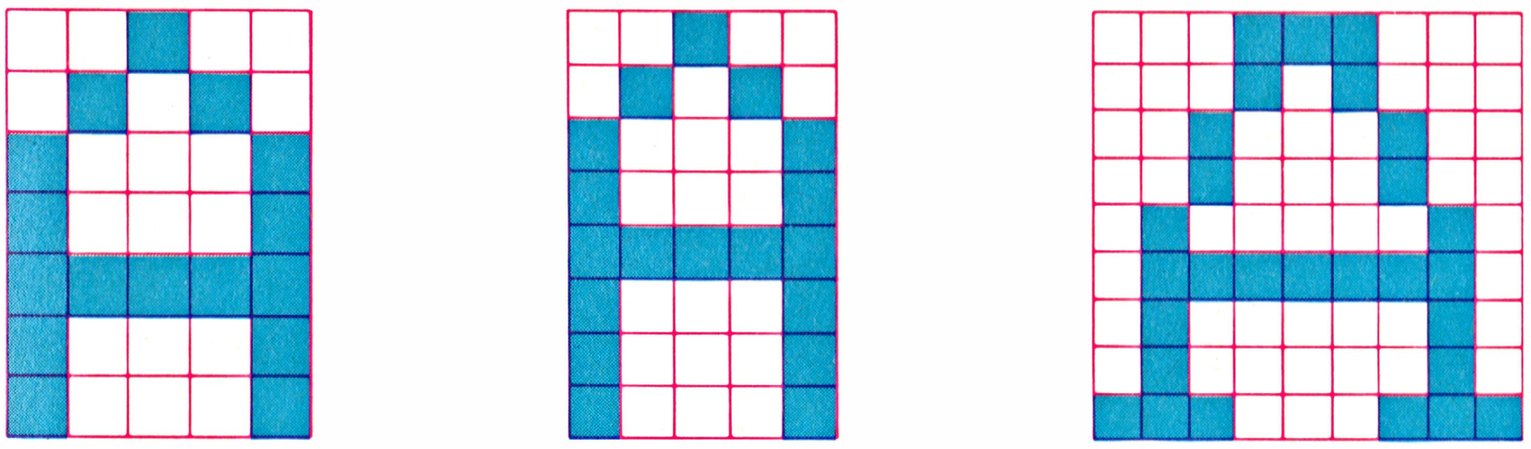
That leaves us with four types of printers, which cover a tremendous variety of features and capabilities: daisy-wheel impact, dot-matrix impact, thermal, and electrographic.

Daisy-wheel printers are ideal for letter-quality output. They produce fully formed characters as clear and crisp as those of typewriters. The print element looks like a daisy with type characters at the tips of its elongated petals. The wheel rotates at high speed, and a hammer strikes the appropriate character as it passes by. The print wheels are easily removable and are available in several styles and sizes.

Daisy-wheel printers are slower than other printers—from 30 to 55 characters per second (cps). They also are expensive—from $1500 to $2000 and up. For top-quality word processing, you can't beat a daisy-wheel printer—if you can afford one.

Dot-matrix impact printers are the most versatile and popular group. Letters are formed on a 5 by 7 or 5 by 8 matrix (five vertical columns, each consisting of up to seven or eight dot positions). More recent models have several character styles and sizes, including high-density matrices of up to 9 by 9. Some can even plot points and create high-resolution graphics.

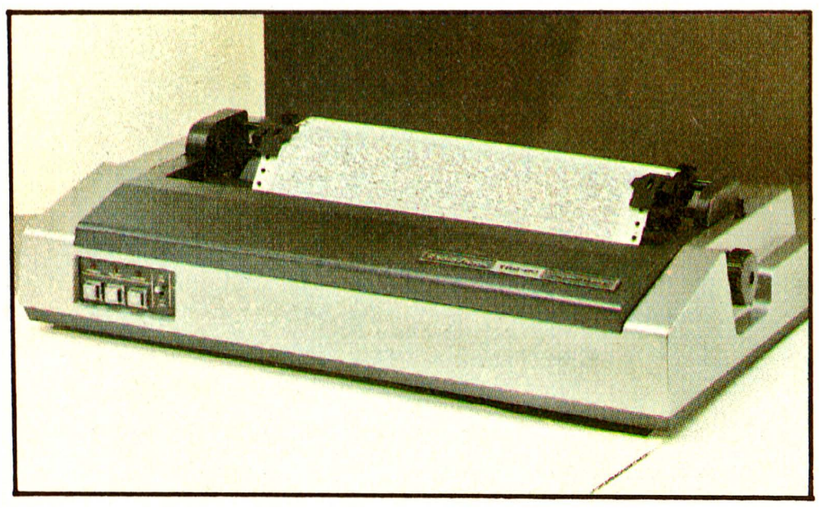
Generally, dot-matrix characters are not as easy, or not as pleasing, to read as fully formed characters. However, some recent units have a letter-quality mode in which the dots overlap to approximate fully formed characters. Dot-matrix printers are fast, ranging from



What's a Dot Matrix?

It's a pattern of dot positions. For example, a sheet of graph paper can be considered a very dense dot matrix. Dense means there are a lot of dot positions on it, allowing a great deal of detail in each character.

The most common dot matrix is 5 by 7. That's five columns, each containing seven dot positions. The figure above compares three different dot densities (5 by 7, 5 by 8, and 9 by 9).



For data processing, you'll probably want a high-speed, dot-matrix impact unit. This one can handle paper up to 15 inches wide (Radio Shack Line Printer VI).

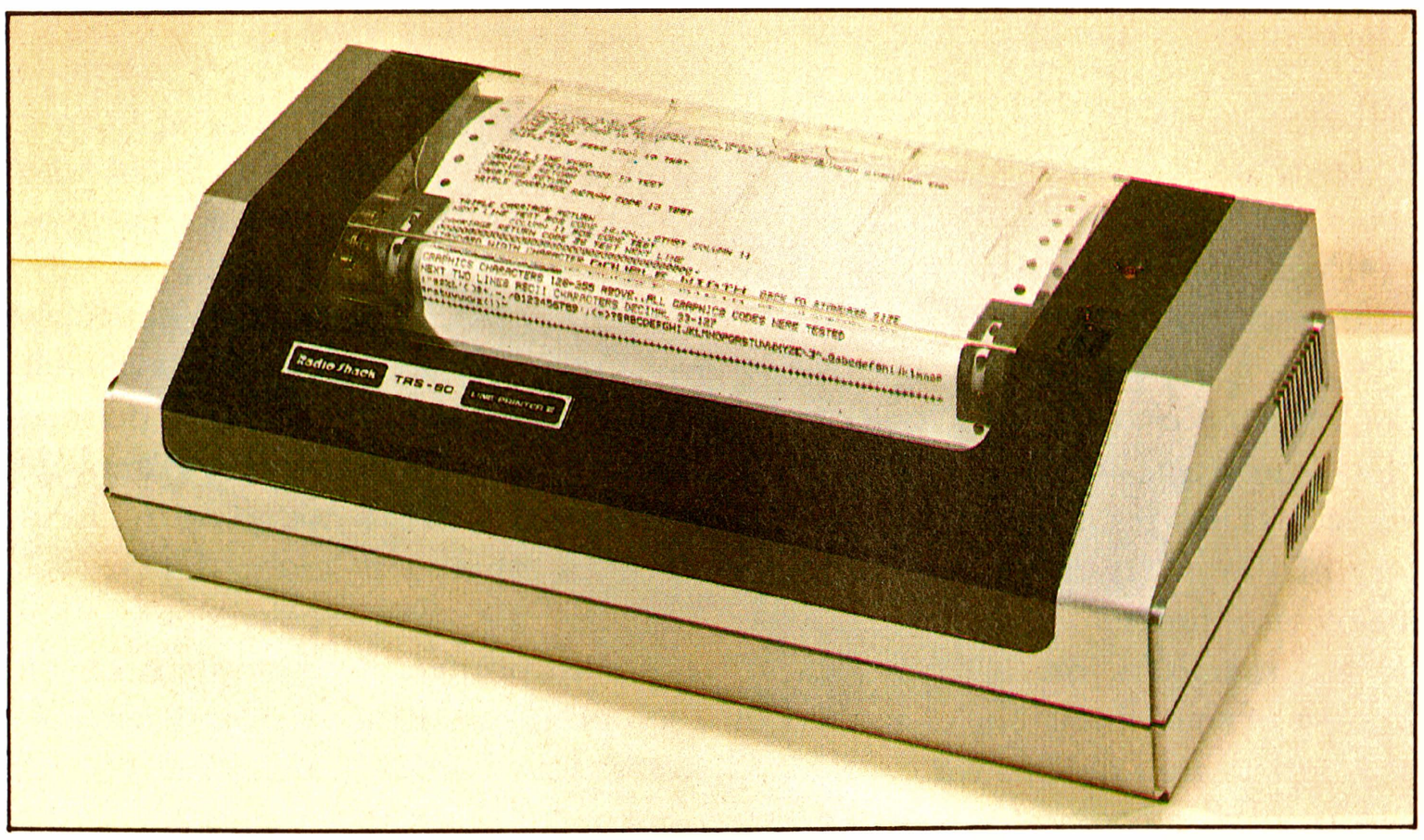
100 to 180 cps. These printers come in a wide price range, from under $500 to well over $2000 for high-speed, data-processing models. With such a wide range of prices and capabilities, dot-matrix printers can be considered for almost any data-processing, word-processing, or general home use.

Thermal printers are among the most affordable (under $200). They produce a dot-matrix character on special heat-sensitive paper. They can be fast (up to 160 cps), quiet, and are usually problem-free because of few moving parts. On the negative side, the paper is more expensive than plain paper and sometimes in limited supply. Furthermore, thermally printed documents will fade if not stored properly. Thermal printers are worth considering for uses that will not consume much paper.

Electrographic printers, like thermals, require special paper. In this case, the paper has an aluminized surface. The printer creates a dot-matrix character on the paper by passing a small current through it, burning away the coating to expose the darker background. If you're not used to reading on this kind of paper, it can be distracting. Like thermal paper, aluminized paper is relatively expensive. These printers are fast (up to 200 cps) and inexpensive (under $500).

Is It Computer Compatible?

You're almost ready for that shopping trip. But first you need to know about a little thing called an *interface*.



Two affordable dot-matrix impact printers. Both have several character sizes and styles, including graphics (Epson MX-80 and Radio Shack Line Printer VII).

Before your computer can begin outputting to a printer, the two units must be connected. (ESP is available only on the mythical omni-printer.) That seems obvious, but there's a lot more to it than simply connecting a bunch of wires. There are matters of voltage levels, timing, protocol (which device says "hello" first), etc. All of these items are handled in the interface.

There are two major interfaces for computer-printer communications, *serial* and *parallel*. The difference between them is not important right now; just find out the kind your computer has and make sure the printer you buy has the same kind. Also, be sure to buy cables specifically designed for connection to your computer.

Evaluating Printers

Okay. You're in the computer store. You've determined what kind of printer you're interested in, and you know it's compatible with your computer. How do you compare one printer with another? We'll list the features to look for and offer some suggestions on weighing one against another.

Speed: Printer speed is given in characters per second or lines per minute (lpm). Most printers in the personal computer market use cps. Printers that output an entire line at once (or appear to do so) use lpm.

One 8½-by-11-inch page of double-spaced text contains approximately 1800 characters. A 30 cps printer does a page in one minute, or thirty pages in

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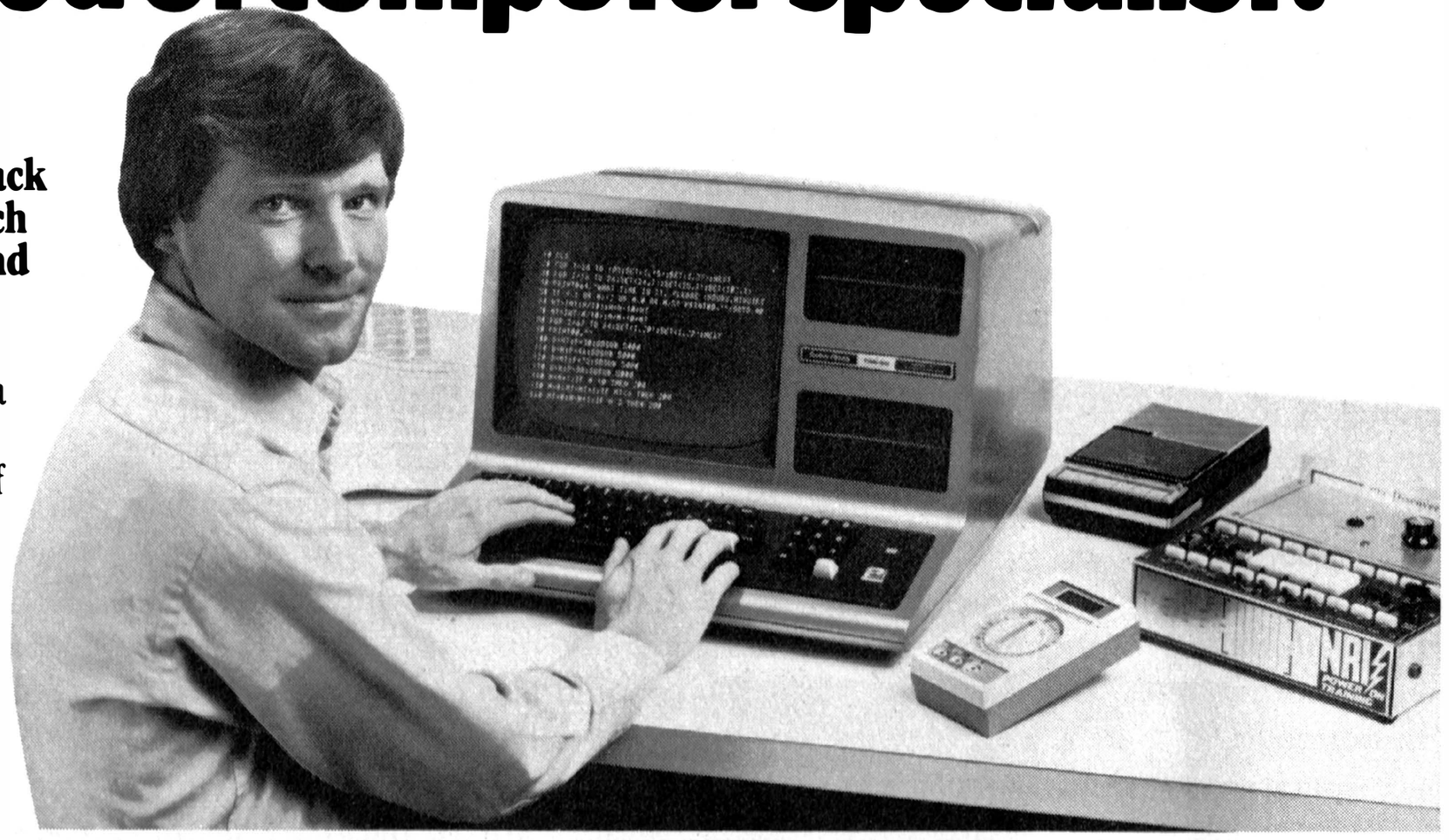

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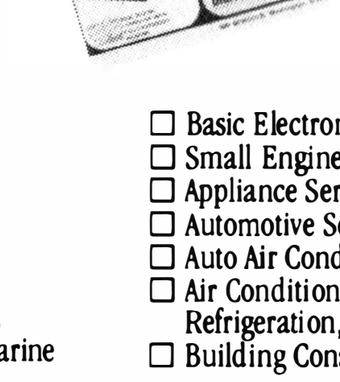

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half an hour. A 150 cps printer does a page in twelve seconds, or thirty pages in six minutes. (But remember, when you're waiting for a printout, *apparent time = 2 × actual time!*)

After you've found out the speed, look for features that make the most of that speed, or in computer lingo, increase the printer's throughput. *Bidirectional printing* is one example. The printer outputs one line from left to right, the next from right to left, then left to right, and so forth. This minimizes the time the print head is moving around without actually putting characters on the page.

Logic seeking is another wrinkle in the speed game. It means that a printer can go directly to the first actual print position on the next line—it doesn't have to start at the extreme left or right margin. Put the last two features together and you have a bidirectional, logic-seeking printer; if *that* doesn't impress your friends, nothing will.

In normal text, there is a lot of white space—paragraph indents, tabulations, double-spacing, and spacing at the top and bottom of pages. Some printers can *logically sum* the characters that produce blank spaces. For example, using logically summed spaces, a printer will do a paragraph indent in one continuous motion, rather than going one space at a time. Using logically summed line feeds, a printer can skip six lines in a continuous motion, rather than in six separate line advances.

Character sets: Until recently, affordable printers could produce only uppercase letters, numbers, and punctuation symbols. But lowercase letters are now available on most units. Many offer a standard set of 96 characters called *ASCII* (stands for American Standard Code for Information Interchange). An increasing number of dot-matrix printers also offer graphics and special characters.

Individual character styles vary wide-

```
ABCDEFGHIJKLMNOPQRSTUVWXYZ
abcdefghijklmnopqrstuvwxyz
```

Figure 1: High-density, dot-matrix printing can be quite readable.

```
 !"#$%&'()*+,-./0123456789:;<=>?@ABCDEFGHIJKLMNO
PQRSTUVWXYZ[\]^_`abcdefghijklmnopqrstuvwxyz{|}~

 !"#$%&'()*+,-./0123456789:;<=>?@ABCDEFGHIJKLMNO
PQRSTUVWXYZ[\]^_`abcdefghijklmnopqrstuvwxyz{|}~

 !"#$%&'()*+,-./0123456789:;<=>?@ABCDEFGHIJKLMNO
PQRSTUVWXYZ[\]^_`abcdefghijklmnopqrstuvwxyz{|}~
```

Figure 2: Daisy-wheel printers usually offer these character sizes (from top to bottom): pica, elite, and proportional.

ly and are subject to your own taste. However, one detail deserves attention here—*lowercase descenders*. Descenders are the tails on the letters "g," "j," "p," "q," and "y." Normally, these drop below the baseline of the other letters. But in many lower-density, dot-matrix printers the descenders are not "true," i.e., the letter is raised so the descender rests on the baseline. If you find this annoying, look for a printer with true descenders.

You should also consider the *character sizes* available on the printer. Measured in characters per inch (cpi), standard sizes are 10 (pica), 12 (elite), and 16.7 (condensed). Pica type is standard for data processing and general purposes. Elite is often used in business letters and legal documents. Condensed is useful when you want to pack many characters onto each line, for example, when you need to print 132-column tables on 8-inch lines. Many dot-matrix printers also offer extended characters (5 cpi, 2.5 cpi); these are nice for headings.

If you do word processing, a useful feature is *proportional spacing*. The pica, elite, and condensed characters are all monospaced: each character takes up the same space. With proportional spacing, however, the space used by each character is proportional to its shape. For example, the letter "i" requires less space than the letter "m." The text you are reading is proportionally spaced. See figure 2 for a comparison. This spacing allows more characters per line but does not appear condensed. For text, it is also easier on the eyes. For tables, columned reports, and program listings, monospacing is preferable.

Control codes: In addition to printing characters, many printers perform a variety of functions under computer control. The most common and useful are:

- backspace (allows overstriking for boldface and special effects)
- tabs (positions are fixed or set by the computer)
- form feed (automatically advances the paper to the beginning of the next form)
- line feed without carriage return and vice versa (for special effects and timesaving)
- bell or tone signal (the only way some systems can get your attention!)

Dot-matrix impact printers are the most versatile and popular group.

Paper: What size paper can a printer handle? How many characters will fit on one line of that paper? Printers are often rated in *columns* per line; this is the same thing as *characters* per line. Can the printer operate page after page without your assistance, or do you need to feed it one sheet at a time? Ask these

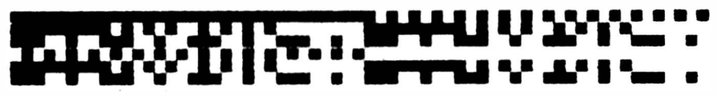

Figure 3: Many dot-matrix impact printers can produce graphics like these, as well as text characters.

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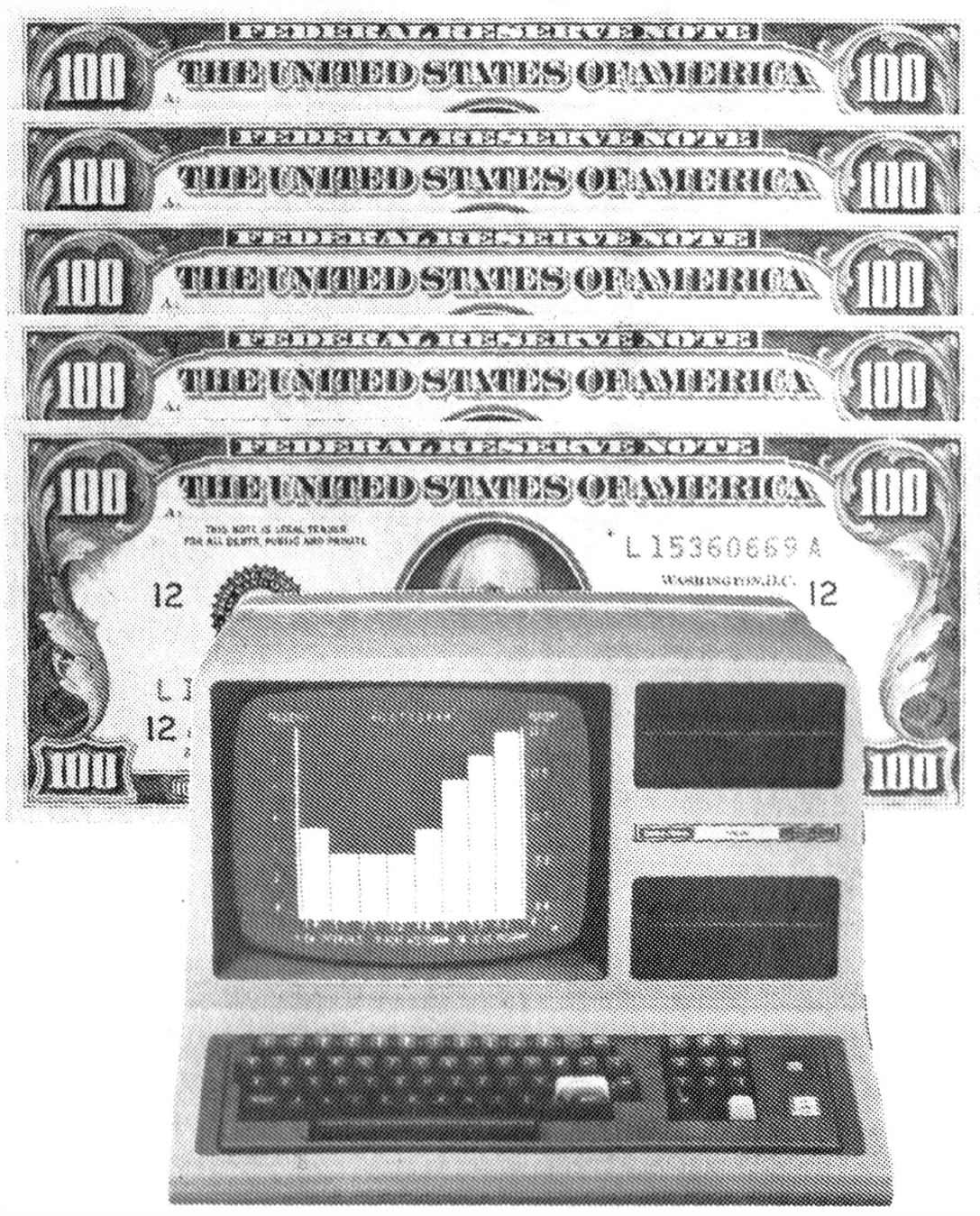

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questions when shopping for a printer.

Thermal and electrographic papers are almost always narrow (40 or fewer characters per line) and usually come on a roll.

If you're looking at impact printers, you'll have more choices in terms of paper size and handling. For word processing, 8½-inch-wide paper is standard. It allows 80 characters per line at 10 cpi. If the printer has a 16.7 cpi mode, you can get 132 characters onto one 8-inch line. For data processing in an office environment, printers should be able to handle paper up to 15 inches wide.

Three methods of paper handling are available: friction feed (as on typewriters), pin feed, and tractor feed. With friction feed, the paper is in sheets or on a roll. With pin and tractor feed, the paper is continuous and fanfolded, with holes along each margin. Pin-feed systems have guide pins on the ends of the platen; tractor-feed mechanisms are external and often more reliable than pin feed. Most dot-matrix impact printers are equipped with both friction and pin feed. Many friction-feed, daisy-wheel units have optional tractor attachments.

One problem with friction feed is paper alignment. During long runs using rolls or other continuous paper, the paper tends to creep to the left or right. There may also be some vertical slippage. This is acceptable in most personal computer applications, but not in repetitive-forms printing where margins are critical.

To eliminate the problems of alignment and manual paper loading, you should get a printer with a pin-, tractor-, or automatic-sheet feed mechanism. Theoretically, such devices allow you to leave while your printer completes a lengthy job. When you return, the output should be waiting for you in a nice, self-folded stack, with margins exactly where you set them. *Theoretically.* But you'll definitely want to watch a few trial runs before putting that much confidence in the paper-feed system.

Speaking of confidence, to know whether you can really trust a printer to behave properly, you must know the answer to another question: Does the printer talk back to the computer? For example, if it's out of paper or ribbon, will the printer stop and inform the computer of the problem? And when you replenish the paper or ribbon, will the printer continue without losing a single character or changing the margin or forms alignment? These capabilities are luxuries for some uses, necessities for others.

After the Honeymoon

Looking ahead, think about operating and maintenance costs, especially in terms of the two major consumables—ribbon (if used) and print heads or daisy wheels. Before choosing between two similar printers, compare the costs of replacing these items. Find out the estimated life of each in terms of total characters printed. How convenient is it to replace a ribbon? Can you replace the print head, or is that a service center procedure?

Noise

This may not seem important in the computer store, but it can become quite annoying in the home or small office. When you compare printers, you'll find a wide variation in noise levels.

Avocado Green or Harvest Gold?

No, it hasn't gone quite that far yet. You probably won't have to add this factor into your comparisons between printers. But as you can see from the number of features we've discussed, it's getting there.

We've summarized the printer types and features in a shopping checklist. Cut it out and take it with you on your next trip to the computer store. (And watch the salespersons disappear!)■

A Printer Checklist

- **Price:** _____
- **Interface**
  - ☐ Serial ☐ Parallel
- **Character Formation**
  - ☐ Dot Matrix ☐ Fully Formed
- **Printer Category**
  - ☐ Daisy Wheel ☐ Dot-Matrix Impact
  - ☐ Thermal ☐ Electrographic
- **Speed:** ____ cps
- **Throughput Enhancements**
  - ☐ Bidirectional ☐ Logic-Seeking
  - ☐ Logically Summed Spaces or Line Feeds
- **Character Sets**
  - ☐ Lowercase ☐ 96-ASCII
  - ☐ True Descenders ☐ Graphics
- **Character Sizes**
  - ☐ 10 cpi ☐ 12 cpi
  - ☐ Condensed ☐ Proportional Spacing
- **Control Codes Recognized**
  - ☐ Backspace ☐ Tab
  - ☐ Bell ☐ Others
- **Paper**
  - ☐ Plain ☐ Thermal
  - ☐ Electrographic
- **Maximum Paper Width:** ____ inches
- **Paper Handling**
  - ☐ Friction ☐ Pin
  - ☐ Tractor ☐ Sheet
  - ☐ Roll ☐ Continuous Fanfold
- **Maintenance and Operation Costs**
  - **Ribbon Life:** ____ characters
  - **Print Head or Daisy Wheel Life:** ____ characters
  - **Cost of Replacement Ribbon:** ____
  - **Cost of Replacement Head/Wheel:** ___
- **Noise Level:** _____
- **Comments:** _____
  _____
  _____

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FEATURES	BYTEWRITER-1	EPSON MX-80*
Print speed	60 lines per minute	46 lines per minute
Paper feed	Friction feed original plus 3 copies	Pin feed original plus 2 copies
Ribbon	Black, cartridge $9.95	Black, cartridge $14.00
Life expectancy	Printhead — 100 million char. Drive Mech. — 10 million char. Ribbon — 5 million char.	50 — 100 million char. 5 million char. 3 million char.
Dimensions	3.8″ × 15″ × 9″	5.2″ × 14.7″ × 12″
Character set	96 ASCII	96 ASCII
Interface	Parallel	Parallel
Warranty	90 days	90 days
Printhead replacement	$29.95	$30
Cost	$299	$650

*Data source: Epson MX-80 Operation Manual

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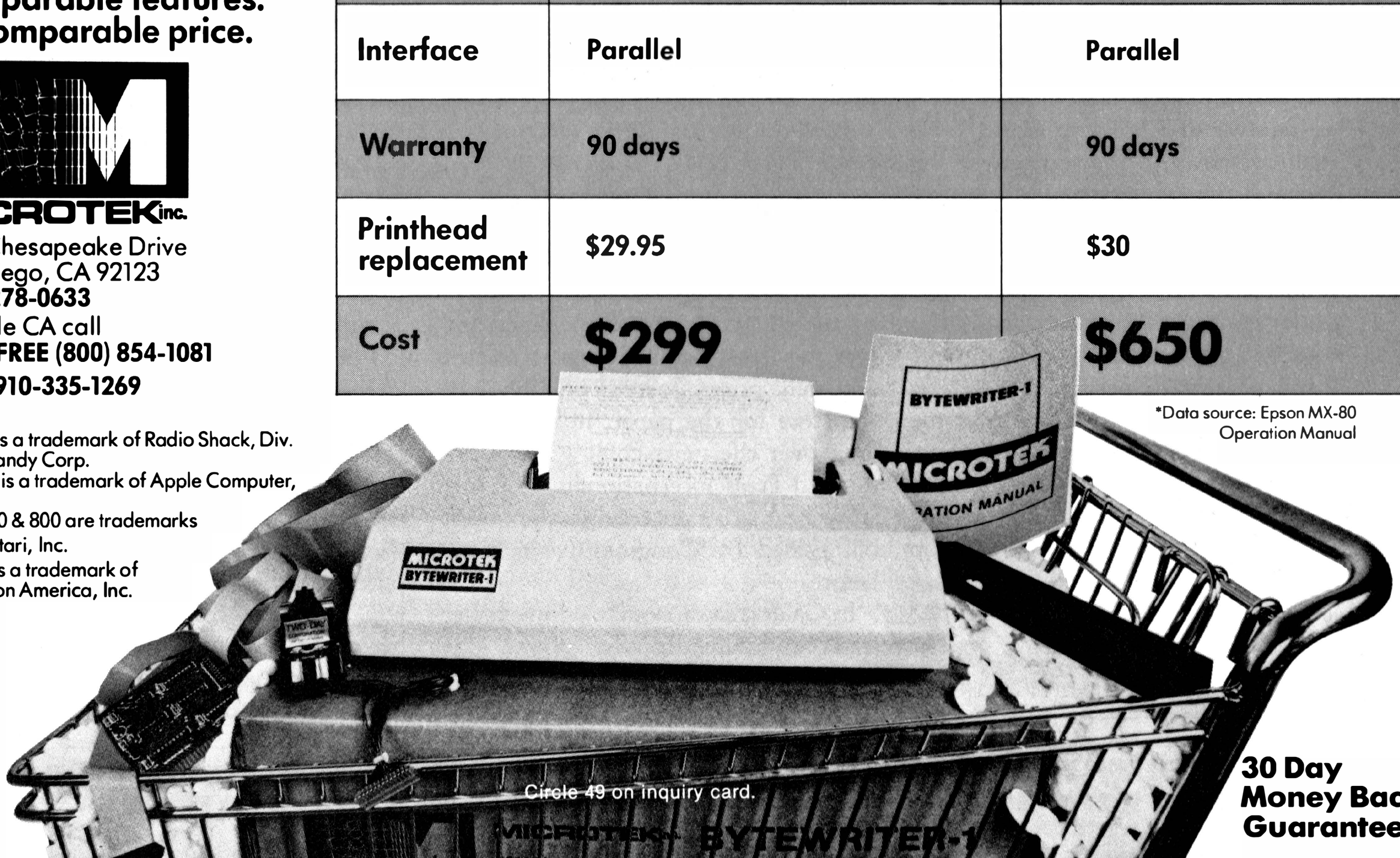

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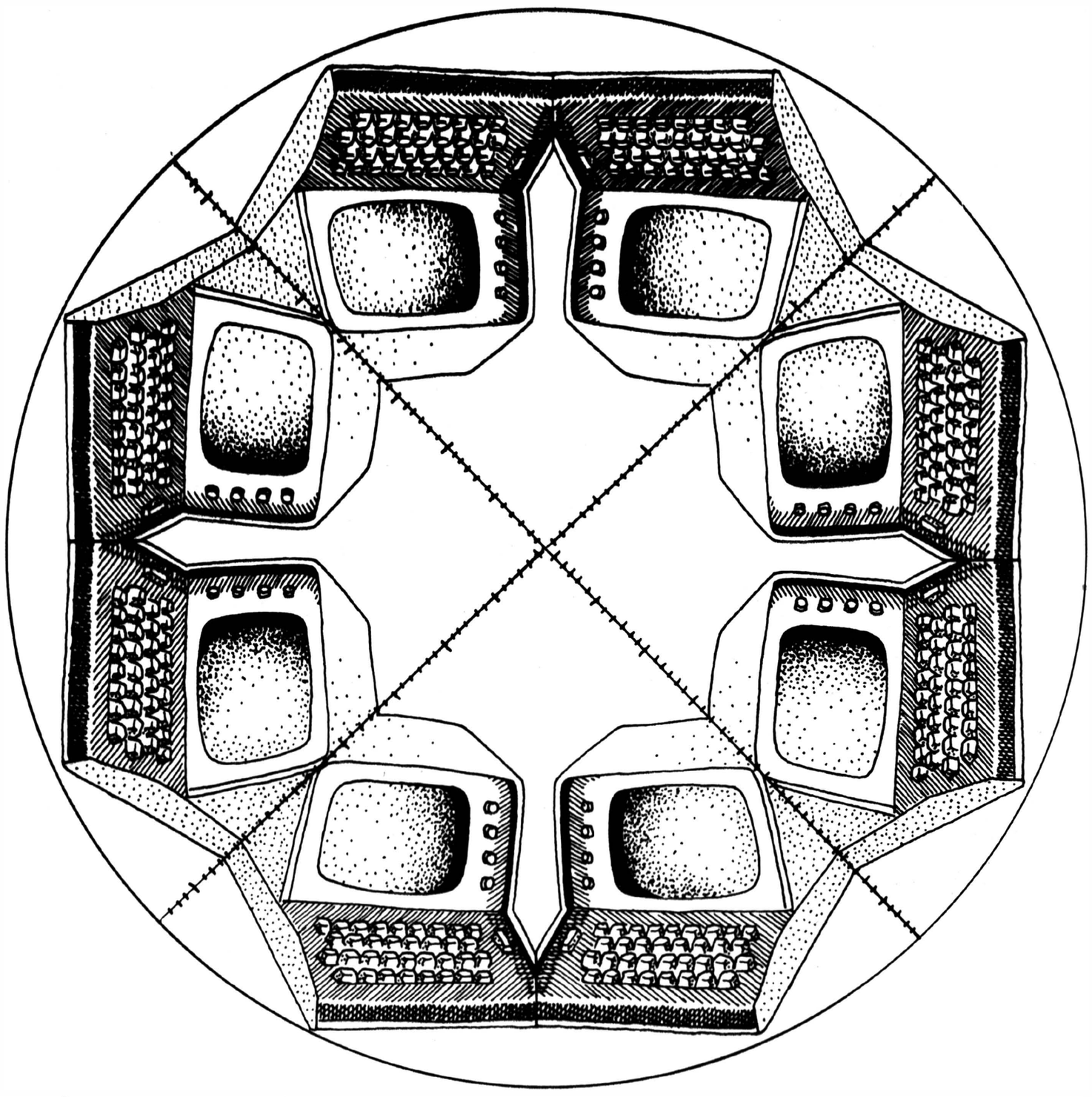

Illustration by Jonathan Graves

Telecomputing

Hooking Your Computer to the World

by Mark Dahmke and Stan Miastkowski

In New York, a businessman planning a trip dials his phone and places the receiver in a box connected to his small computer. Minutes later, an up-to-date listing of flights to his destination appears on his screen. When he has chosen the flight he wants, he pushes a few buttons and his reservation is confirmed. He then makes his hotel and car reservations and requests a list of restaurant reviews for his destination city. Next, he checks the progress of the stocks in his portfolio. The quotes he sees were updated minutes ago. Just as he's about to hang up, he remembers hearing a radio report that quoted a midwestern newspaper. With the push of a few buttons, he has the complete text of the newspaper available to him and is soon reading the entire story.

On a secluded dairy farm tucked away in the far northern reaches of Vermont, a farmer connects his small computer to the telephone lines and gets the latest detailed weather report and milk prices. Instead of driving to the store for the paper, he decides to look over the news coming from UPI (United Press International). The first story he reads concerns an important bill passed by Congress five minutes before.

In California, a woman connects her small computer to the phone line before heading off to her job. Her appointment calendar (stored in a huge computer complex in suburban Washington) reminds her of her dentist appointment at ten that morning. She then checks her horoscope and asks the computer for a list of other people who are connected to the computer. Seeing that a friend in Chicago is "on-line," she types a message to him and spends the next fifteen minutes "chatting" through the keyboard of her small computer. In the few remaining minutes before heading off for work, she checks the national classified ads and takes a look at career opportunities in the Chicago area.

A researcher in Dallas has been assigned to find all available information on the social habits of an obscure Asian tribe. Rather than driving to the library, she connects her computer to the phone and calls up a huge computer system near San Francisco. She simply types in the name of the tribe and the words "social habits." In a few seconds, the computer searches through billions of records and comes up with a list of 57 articles about the tribe (perhaps they're not so obscure after all). By pushing a few more buttons, she orders reprints of all the articles, which are delivered with the next morning's mail.

These scenes don't come from science fiction. All the services listed above (and many, many more) are available *now* through the telephone lines. They're part of a field called *telecomputing* (computing at a distance)—a field that's one of the fastest-growing segments of the small computer industry. Within the next few years, the technology of telecomputing will touch all our lives by allowing anyone with a small computer to hook up to huge computer systems and data banks.

Telecomputing isn't new. Not long after computers came into general use in the 1950s, computer companies realized they could sell computer time to small companies who couldn't afford their own computers. (Remember, we're talking about the days when computers cost *millions* of dollars.) Thus was born the concept of the *service bureau*, whereby hundreds of companies, connected to a large central computer via phone lines, all shared

---

Mark Dahmke is consulting editor and Stan Miastkowski is managing editor of Popular Computing.

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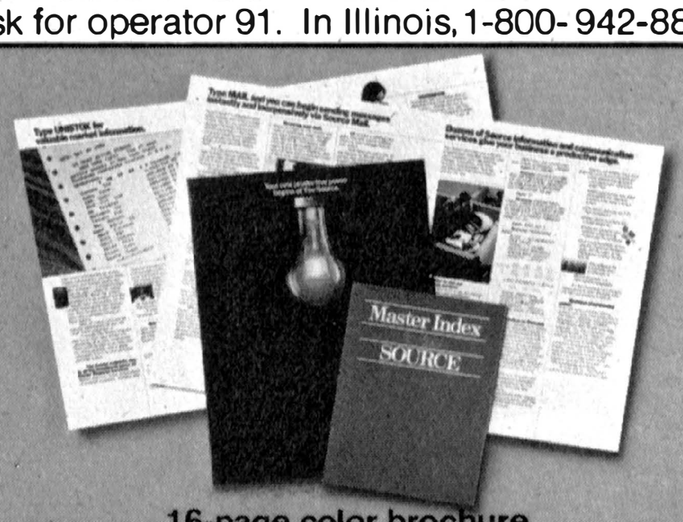

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The service bureaus hummed along contentedly until the minicomputer appeared on the scene in the early 1970s. As more and more companies bought their own small computers, fewer turned to the service bureaus. By the late 1970s, nearly any company that wanted a small computer could afford one.

But the service bureaus, too, began changing with the times. Realizing there are many functions (including the ones described at the beginning of this article) that a small computer can't perform alone, the service bureaus decided to offer some of their extra time to users of small computers. That decision marked the beginning of telecomputing for small-computer users—and the revolution has barely begun.

A Look at What's Available

Two major companies now offer wide-ranging telecomputing services to small-computer owners. The Source, a subsidiary of Reader's Digest, is located in McLean, Virginia. The second firm, CompuServe, operates from computer centers in Columbus, Ohio. Both companies offer services ranging from news to games to classified ads to you-name-it.

In addition to the generalists, a growing number of companies provide specialized telecomputing services designed for specific applications. One of the oldest is the Dialog Information Retrieval Service, whose huge computer complex is located in suburban San Francisco. Dialog was originally developed to index and store the hundreds of thousands of documents generated by the space program in the 1960s. It now offers one primary service—an index of billions of citations and abstracts on every imaginable subject. Because of the high cost, Dialog's services are used primarily by professionals at libraries and universities. But the consumer market beckons; Dialog is about to introduce a low-cost service designed for users of small computers.

Not dependent on a large computer, the computerized bulletin-board systems (CBBSs) represent one of the fastest-growing areas of telecomputing. Bulletin boards began as message and software exchanges for computer clubs and hobbyist groups, but their numbers have swelled along with the ranks of small-computer users. Hundreds of CBBSs now exist all over the country. Many specialize in particular areas such as photography, ham radio, or aviation. For the latest listing of CBBSs, you can call (213) 881-6880, 24 hours a day. When the system gives the message LOGON PLEASE, type CAT. The service is provided by Novation Inc. of Tarzana, California, a manufacturer of modems.

Unlike the huge computer systems that enable the "big boys" to handle thousands of telephone calls at one time, a typical CBBS consists of a single small computer hooked up to a single telephone line. Only one caller at a time can get through to read messages and add new ones. Best of all, CBBSs

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Joining the Revolution

On your end of the telephone line, you need three things to hook up your small computer to one of the telecomputing services:

- a computer with an RS-232C serial interface
- a modem (modulator/demodulator)
- software that lets your computer act as a terminal.

Although the name sounds threatening, an RS-232C serial interface is simply a circuit that allows your small computer to send information over the telephone lines. Most personal computers already have one built in; check your instruction manual or call your local computer store to find out about yours.

A *modem* is a device that takes the electrical signals put out by your computer and turns them into tones that are sent over the telephone lines. The modem also takes the tones sent by the computer at the other end and turns them into electrical signals your computer can display on its screen as text. There are two types of modems: the direct-connect modem and the better-known acoustic coupler. When using an acoustic coupler, you dial the number on your telephone, wait for the high-pitched tone indicating the computer is connected, and put the handset into a cradle with rubber cups that isolate it from outside sounds. A direct-connect modem plugs right into the telephone jack, eliminating the distortion often caused by the telephone microphone and receiver. You can choose from a bewildering array of modems of both types, most selling in the $100 to $200 range.

The third essential for hooking up to a telecomputing service is terminal software, a program that disconnects many of your small computer's features and makes your computer, in effect, a terminal of the computer to which you've hooked up. Most terminal software costs less than $25, but advanced packages selling for up to $200 can dial the phone number and even log onto a system. If you're good at advanced programming, you can write a terminal program yourself. Most companies offer advanced owner's manuals that tell you how.

Computing the Cost

After you have all your equipment together, you'll still need an account number and a password to log onto the big systems (unlike the computerized bulletin boards, which are free). Fees for hooking up to and using telecomputing services can vary widely. In addition to the hourly use charge, most major services charge a first-time hookup fee. The Source's initial charge is $100. For CompuServe, the charge varies between $20 and $30 depending on the type of terminal or computer you'll be using. Dialog, whose hourly fees are much higher, doesn't charge for hookup.

After you've paid the initial fee and received your account number and password, you're almost ready to begin. You still need to connect to the big computer, which you can do in one of two ways. The most obvious way, a long-distance telephone call, can get very expensive, especially during the prime-time hours. As an alternative, two national networks, Telenet and Tymnet, send computer data all over the world. The two networks can be reached through local numbers in most metropolitan areas, but if you don't live in an area where they're served by a local number, it's usually a short-distance call. Most of the major telecomputing services are hooked up to both, and both charge a flat fee regardless of the distance involved. Telenet charges $5 an hour, Tymnet, $8 an hour.

Fees for actual use of the computer systems vary with the time of day. During nonprime time (6 p.m. to 5 a.m. in your local time zone), CompuServe charges $5 an hour. To discourage use during prime time, the charge jumps to $22.50 an hour. The Source charges $4.25 an hour during some nonprime hours, and $2.75 from midnight to 7 a.m. The fee for prime-time use is $15 an hour. Both services accept major credit cards.

Dialog's fee structure is more complicated. Each of the service's approximately 130 data bases has a different hourly charge, with an average of about $75. The hourly charge for Dialog's consumer service is expected to be closer to $25 an hour, but details are not yet available.

For now, the major drawback to using the information utilities is cost. The expense of a long-distance telephone call, network charge, and usage charge can add up quickly, but it's a sure bet some of these costs will decline dramatically as more and more people begin using the services. And as the networks expand, they'll be within local calling distance for almost everyone. In the meantime, the best solution to the shrinking wallet syndrome is to use the services wisely. Get on, find the information you need, and get off. Think carefully about how you'll be using the system. It might be cheaper to buy a particular game, for example, than to play it over the phone lines.

This article has given you a quick overview of telecomputing, but we've only scratched the surface of this growing field. Next month we'll begin a monthly telecomputing column that will examine in detail each of the subjects we've mentioned here. If you have comments or questions, write to Telecomputing, Popular Computing, POB 397, Hancock NH 03449. (If you're a user of The Source, you can send mail to TCG-847.)

Happy telecomputing! ■

For more information about the companies mentioned in this article, write to:

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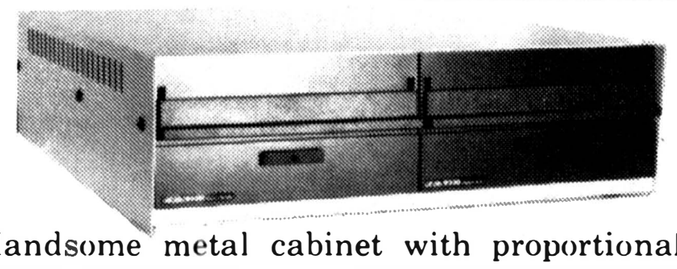

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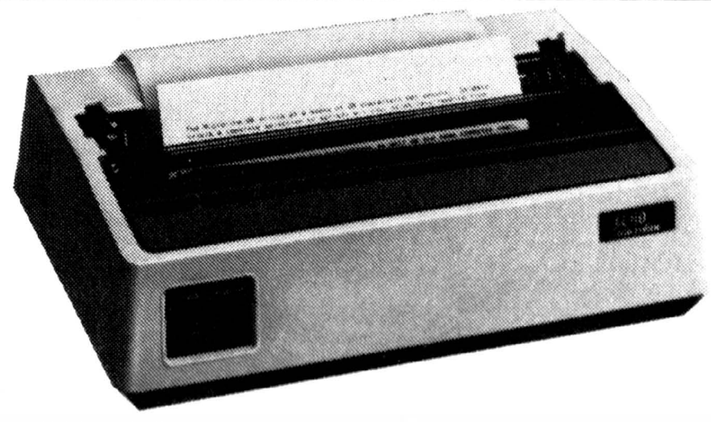

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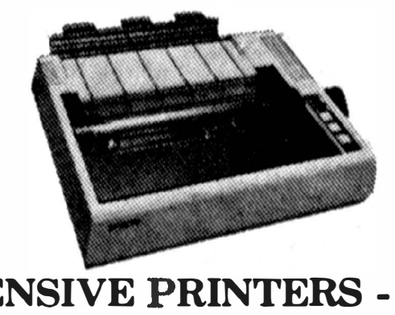

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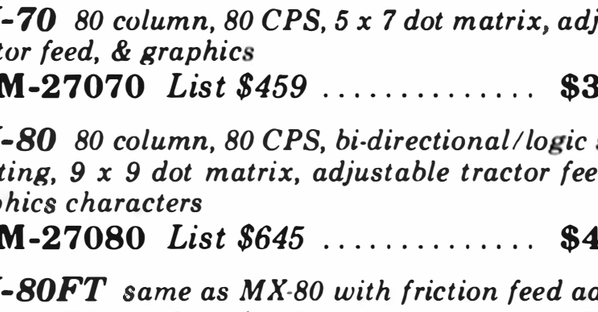

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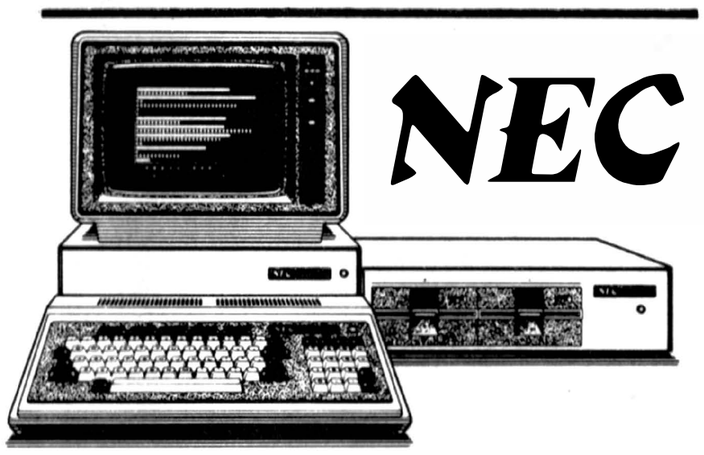

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Book Reviews

The Analytical Engine

by Jeremy Bernstein
William Morrow and Co., New York, 1981
131 pages, softcover, $4.95.
Reviewed by Beverly Cronin

For someone whose knowledge of computers is limited, say, to recognizing the names of the most popular brands in magazine ads, *The Analytical Engine* is a great primer.

From the abacus to artificial intelligence, Jeremy Bernstein traces the evolution of the computer and discusses the revolutionary impact it has had on society. Along the way, we are introduced to common computer terms and given a glimpse inside what many of us would refer to as that magic machine—the computer.

The Analytical Engine was first published nearly twenty years ago, compiled from a series of articles in *The New Yorker*. Bernstein's original intent was to "demystify" the mystifying. "What I tried to do at that time was to show that, basically, these machines were merely applications of human arithmetic skills"—an explanation adequate for the time, perhaps, but simplistic considering today's sophisticated applications. Bernstein is well aware of this, however. In this revised edition he addresses the complex nature of computing in the 1980s and considers what we might expect in years to come.

Bernstein begins with an account of his own introduction to computer programming in a class in the high-level language FORTRAN. As he recounts problems and solutions he faced in that initial effort, we get a step-by-step explanation of how one approaches using a computer and the reasoning behind each step. (Bernstein says his first lessons in FORTRAN were not too difficult. But we suspect that he, as a physicist, had an edge over us nontechnical folk.) This breakdown of the complex process of program writing into easy-to-understand steps helps immensely when one is trying to understand just how the computer goes about its business of manipulating data.

For background, Bernstein presents the milestones in the development of the modern computer. Among these are the invention of the slide rule (really an analog calculator) in 1622 by the English mathematician William Oughtred; Blaise Pascal's mechanical adding machine of the mid-seventeenth century; and Charles Babbage's Difference Engine, completed in 1822. All necessary facts, of course, for anyone who would be well versed in computers.

Bernstein devotes a great deal of space to Babbage, and it's warranted. (Pascal fans, though, will surely bid for equal time.) Babbage's vision was far-reaching, indeed. His ideas form the foundation on which today's computers are built. For example, he divided the computer into four main parts: store, mill, transfer device, and mechanism for input and output. They correspond to memory, arithmetic unit, control unit, and input and output devices of today's computers. Also, he envisioned a machine that could operate on its own, without human intervention. And he anticipated the ability of an automatic computer to perform conditional operations (the IF statements in high-level programming languages). But, Bernstein notes, "Babbage's work was forgotten until the 1940s, when another generation of scientists and engineers, struggling anew with the problem of designing large-scale digital computers, came to realize that Babbage, with all his gears and cranks, had been there before them."

Having brought the reader into the twentieth century, Bernstein discusses the "modern era of mechanical computation," whose beginning he dates at about 1925. He gives us some background on the early work done at Harvard, MIT, and IBM. At this point, Bernstein's personal association with pioneers in the field lends color to the

Continued on page 110

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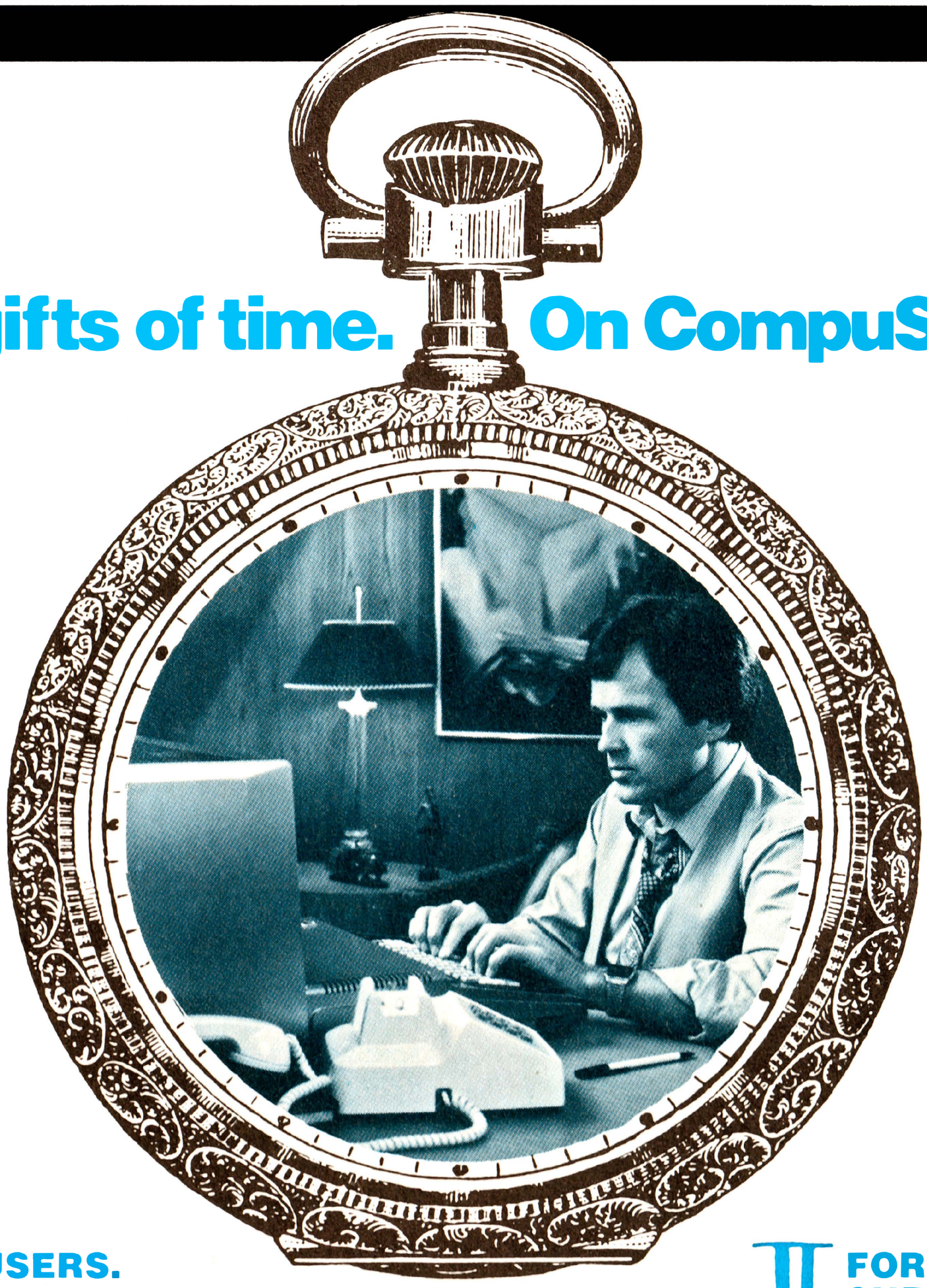

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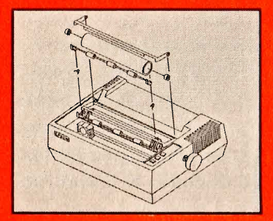

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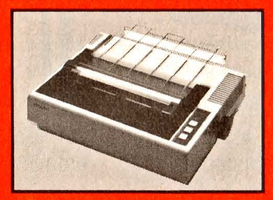

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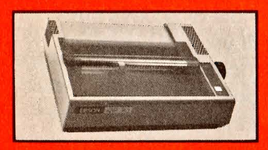

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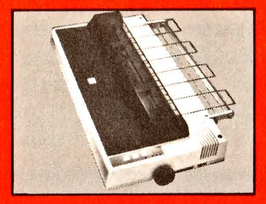

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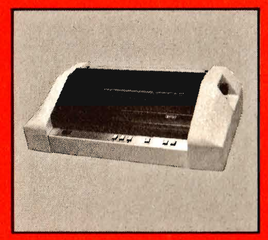

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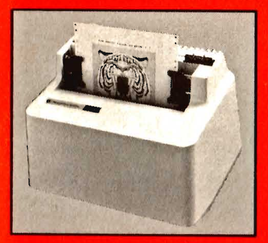

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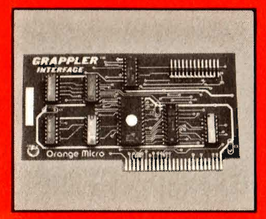

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How Should Schools Use Computers?

The Debate Heats Up

by George Stewart

Illustration by William Giese

"Computer games are mindless and don't belong in the classroom."

"I disagree—they are one of the best ways to introduce computers to students."

"Put the computers in the math department."

"No, put 'em in the English department."

"Library!"

"I've gotten amazing results with drill-and-practice sessions."

"What a waste of time—use computers to teach problem-solving skills."

* * *

How should computers be used in the classroom? That's what educators are arguing about now. Long gone is the question "*Should* we use computers in schools?"

The National Educational Computing Conference (NECC), held last summer in Denton, Texas, offered a representation of the diverse and often conflicting opinions about how computers should be used in schools. More than a thousand teachers, administrators, educational suppliers, and computer representatives gathered for a series of lectures, discussions, tutorials, and demonstrations. The participants knew they had an ideological tiger by the tail, and the result was a lively, stimulating conference.

George Stewart is a technical editor for Popular Computing. *Lorraine Smith is a newsstaffer in the McGraw-Hill World News Houston/Dallas Bureau.*

What Is It?

Is the computer a new tool or a new subject? This is the most fundamental issue in the computers-in-education debate. Computers can be programmed to present information to an individual student and then test the student for comprehension. The subject matter can be anything from English literature to computer science itself, and the testing can be customized to each student. What is important is that the computer is being used as a new *tool*, a new way of teaching. On the other hand, computers can also be programmed by the student to explore ideas and solve problems of his or her own choosing—from making a game to creating a graphics image on a display screen. In this case, the computer is the *subject* of discovery.

Arthur Luehrmann, founder of Computer Literacy, Inc., divides computer use into three categories: learning from, learning with, and learning about.

Learning from includes the educational approaches known as computer-aided instruction (CAI) and computer-managed instruction (CMI). In CAI, both the subject and tests are presented by the computer; in CMI, the subject matter is external (in a textbook, for example), and the computer merely directs the student's use of these materials, based on the results of tests administered by the computer.

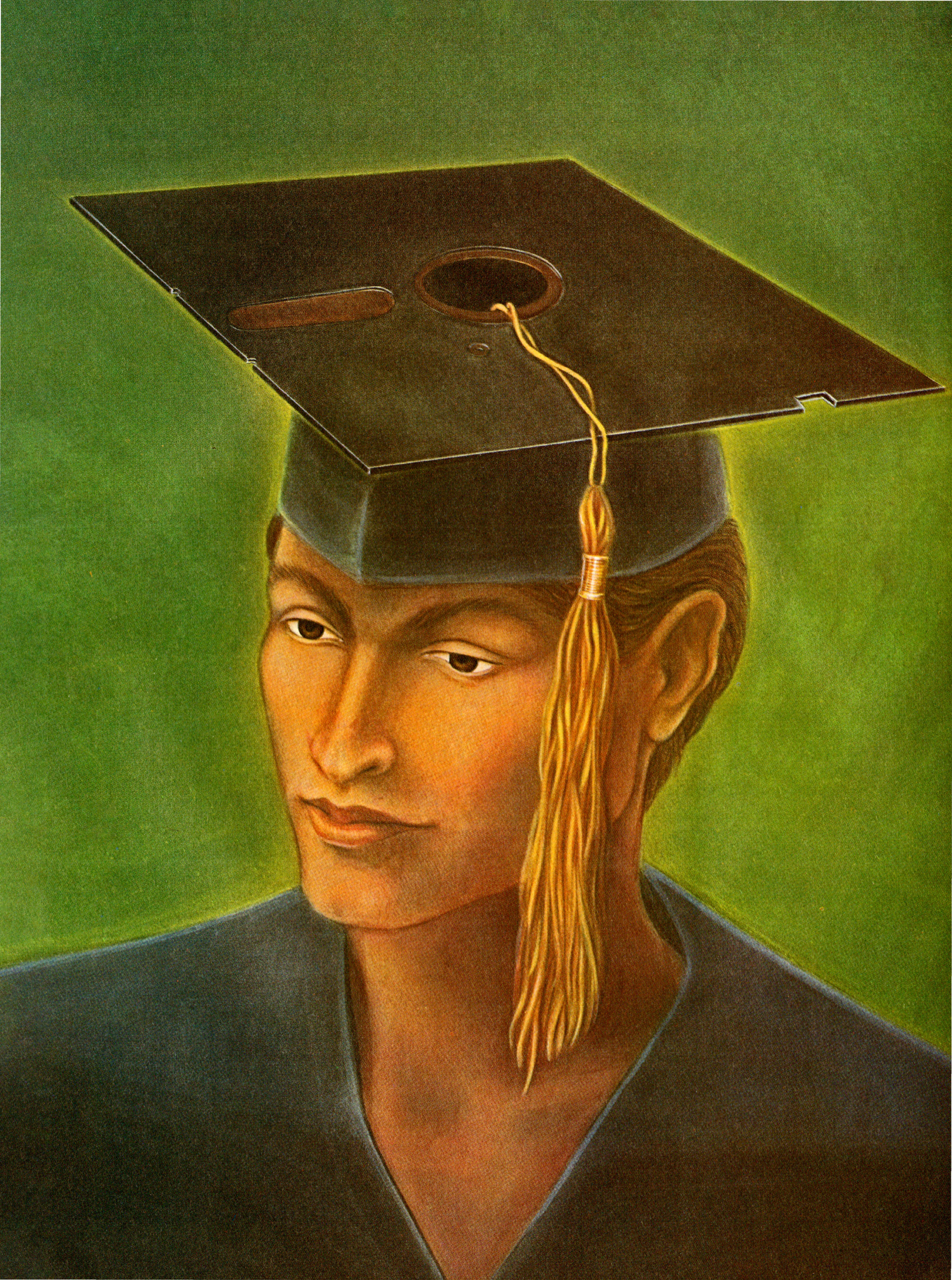
Learning with includes using the computer for problem solving and carrying out simulations. Typical examples are using the computer as a high-powered calculator or using it to predict the growth rate of a population of bacteria.

Learning about takes the computer as its subject; this program of learning is also called computer literacy, Luehrmann's main interest. In his words, "The goals of a computer-literacy program are to teach programming and programming skills, new ways of thinking, planning skills, and debugging strategies."

Criticisms of CAI

For Luehrmann and others, the problem with CAI and CMI is one of resource allocation. Luehrmann put it, "When computers are in limited supply, CAI is the last thing we should be using them for." These people argue that CAI merely replaces or duplicates traditional educational tools; computer literacy, on the other hand, is a new subject that must take priority over all other uses of computers in education.

Some criticism of CAI goes deeper. CAI is a poor way to learn, some educators claim. Many of the CAI packages are simply drill-and-practice tools, with the added feature that the computer selects problems to match the student's demonstrated mastery of the subject. Such programs lead the students down predefined pathways in which only right answers are rewarded. The criticism is that the *best* kind of learning takes place when a student is free to pursue *all* the answers—right and wrong—to see where they go. As Grayson Wheatley of Purdue University said, "Learning is best facilitated when we assume that individuals con-



struct answers for themselves." Luehrmann believes, "Good teaching involves letting people make mistakes."

Criticisms of Computer Literacy

The *learning about* approach also has its critics and problems. For one thing, the goals of a computer-literacy program are often vague. For example, in teaching a programming language, are we simply conducting a vocational-training operation? Many educators object to the inclusion of vocational training in the core curriculum. As James Rutherford said in his keynote address to the NECC, "It is not the job of the schools to train students for jobs." (Rutherford is an adviser to the American Academy for the Advancement of Science.)

Some educators and equipment suppliers completely deny the importance of computer literacy. Glenn Polin, of the Apple Computer Company, jokingly compared the computer-literacy crisis to the "automobile-literacy crisis." He maintained that in a few years we won't need to understand anything about computers except how to operate them—how to run a particular applications program. Polin concluded that by the time a computer-literacy program is in place in the school system, it will be obsolete.

Computer-literacy advocates, on the other hand, argue that Polin's definition is very limited. They say he is ignoring all the secondary benefits of computer literacy, for example, Luehrmann's "new way of thinking."

In addition to the major debate on how computers should be used in the classroom, there are other important concerns:

- What should a computer-literacy curriculum consist of?
- Where does computer literacy fit into the existing curriculum?
- Who should teach the subject?

Concerning the last two questions, many educators believe the computer's place is in the math department. Luehrmann thinks this is a serious mistake. "Math should be the last application introduced," he told the NECC attendees. According to him, English teachers would make wonderful computer-literacy instructors, with their training in semantics, syntax, and communication.

As for a comprehensive curriculum for computer literacy, there isn't one yet. And that puts the computer-literacy movement at a disadvantage when it comes to software.

In terms of existing software packages, computer-aided instruction clearly predominates. Individuals, hardware manufacturers, educational consortiums, and publishers are all stocked with CAI programs on every subject from grammar to genetics. Why? Because the programmer's task is well defined: take this or that textbook and turn it into a computer program. Programmers for computer literacy do not have that convenience and clarity of purpose yet; as a result, there are fewer software packages for computer literacy.

Other Issues

Other unsettled issues relate to the equipment itself. When it comes to buying computer equipment, schools have problems similar to those of individuals. Typically, a large purchase is involved, and many individuals will be affected by it. So the purchases must be carefully justified; "I liked that one" won't cut it in the school system.

How do school purchasing agents make such momentous decisions? For most school equipment, they publish a specification of what they want and compare bids received. With computers, it's not so simple. There are so many different equipment features and designs that no single set of specifications will serve as an adequate criterion for making a purchase decision. The trial-and-error approach may suffice for a while, but as more and more school systems buy computers, the specifications issue could become red-hot.

Some educators doubt that the computer in its present configuration is appropriate for educational use. The keyboard/video-display console was developed more than twenty years ago for general data processing. Should it be accepted for school use without modification? With computer-aided instruction programs, the student rarely needs the full power of the keyboard. In elementary education, the keyboard may actually be an impediment to using the system. Low-resolution video displays are awkward tools for demonstrating geometric and artistic concepts. Nonstandard devices—like Xerox's "mouse," the television-game "paddle," and LOGO's "turtle"—might be better suited for many applications.

On the other hand, some educators do accept the computer in its present form. Luehrmann, for example, suggested that so many jobs of the future will involve computer use that "keyboarding should be taught to every child by the time he or she reaches the third grade." Dallas teacher Coleta Lewis recommends the use of keyboards in early education programs because they help teach the alphabet.

Conclusions

How will these issues be decided? Computer-literacy advocates are definitely the underdogs now. So are the proponents of specialized equipment. But that's hardly surprising. Although their goals are creative—some might even say revolutionary—they are also difficult to achieve. On the other hand, the CAI and standard equipment groups have goals that are more specific and achievable.

As educators develop a more sophisticated view of computers in education, computer literacy should generate a great deal of interest. After all, it is much more than another method of *using* computers; it is a method of apply-

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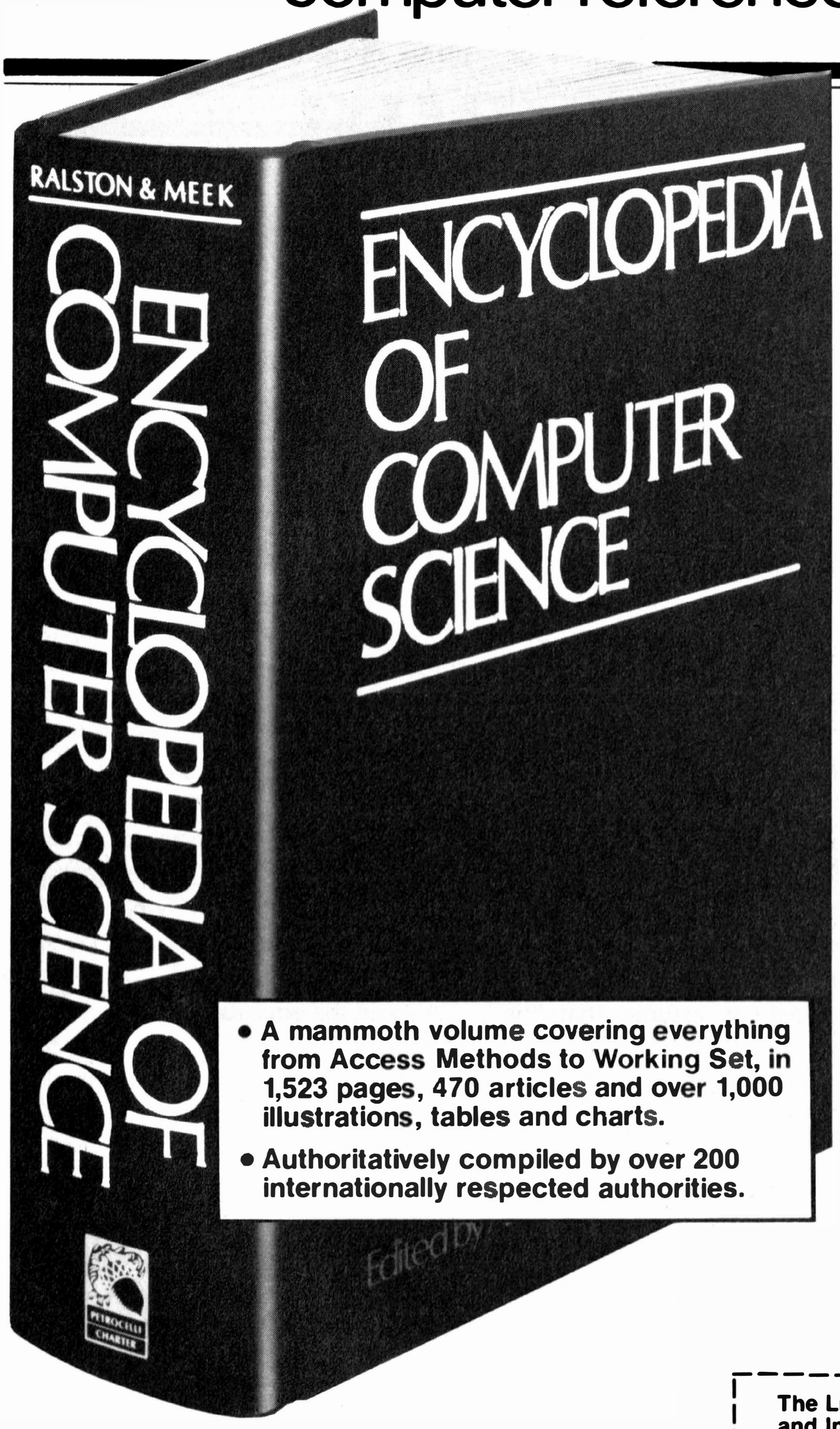

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Appendices provide abbreviations, acronyms, special notations and many numerical tables. An additional highlight is a complete cross-reference system that assists the reader seeking in-depth information.

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ing another *philosophy* of education. Piaget, Montessori, and others long ago established the benefits and arguments for education by doing and exploring; the computer is just a way to make these goals feasible. That's the real meaning of computer literacy.

Perhaps the best thing that could happen is for educators to restrict the urge to label every computer use as either computer-aided instruction or computer literacy and focus instead on what educational philosophy is represented in a given computer program. Labels have a way of becoming meaningless rallying cries; there are already plenty of them in the educational system. ■

Choosing a Computer for Education by Lorraine Smith

Purchasers of small computers have to beware "the creeping feature creature that lurks inside computer systems," said computer expert Douglas Gale of Cornell University in Ithaca, New York. "This phenomenon is almost universal among computer owners, and there is no known cure for its bite."

Gale, who heads a group providing hardware and software support for staff members at Cornell who own computers, said his mythical beast grew out of the tendency he observed among schools to acquire a computer system designed to do X, Y, and Z. As soon as it is working, they decide "wouldn't it be nice if...," and add other features. As a result, 50 percent of their entire development time is in the area of "wouldn't it be nice if..."

As software is developed for these new applications, costs for the programs as originally designed probably will be doubled.

"Our group determined that 50 percent of the software cost of a system is for maintenance. If a system was designed right in the first place, there should be no software maintenance. But by the time you are done finding new applications and have paid for the entire project, multiply your original cost by two, and that is how much you are going to spend adding all these little extra features."

Furthermore, Gale advised educators that planning a system takes twice as long and costs twice as much as you think it will.

According to Gale, while the cost of hardware has declined dramatically and continues to go down, the total cost of computing is going up. He attributes this to the growing sophistication and increased capabilities of the hardware and the more sophisticated software required to take advantage of this.

Buyers should also realize that small computers are not toys. They are real working computers and require the same tender loving care and feeding as their big brothers. You will have the same problems on a scaled-down version as you have when running very large computers.

There's a real problem in the area of service, Gale reported. For large computers, it is "very good." For minicomputers, it is "adequate and getting better." But in the case of microcomputers, it is "not very good."

He also warned that problems can arise with small computers if an application requires that data be transferred to or from other computing facilities.

"Good file-transfer technology and good inter-machine compatibility do not yet exist for small computers, so if you want to transfer data from one machine to another, do not assume that the capability exists at present."

The most optimum cost effectiveness is usually achieved when using the smallest machine that will adequately do the job, he advised educators, warning that overkill in terms of size can cost many extra dollars.

"The first and most important step in selecting a computer," said Gale, "is to define in writing exactly what you want the computer to do—this will take about 80 percent of your time—and develop a limited list of suppliers and systems, as well as criteria for evaluating systems.

"After the system has finally been selected, the hardware and software configuration finalized, a contract negotiated, the site prepared (such as adding extra wiring), and the system installed, give the system a thorough check. Make sure a system passes all acceptance tests before you pay the bill. This is a protection for the vendor, as well as for you."

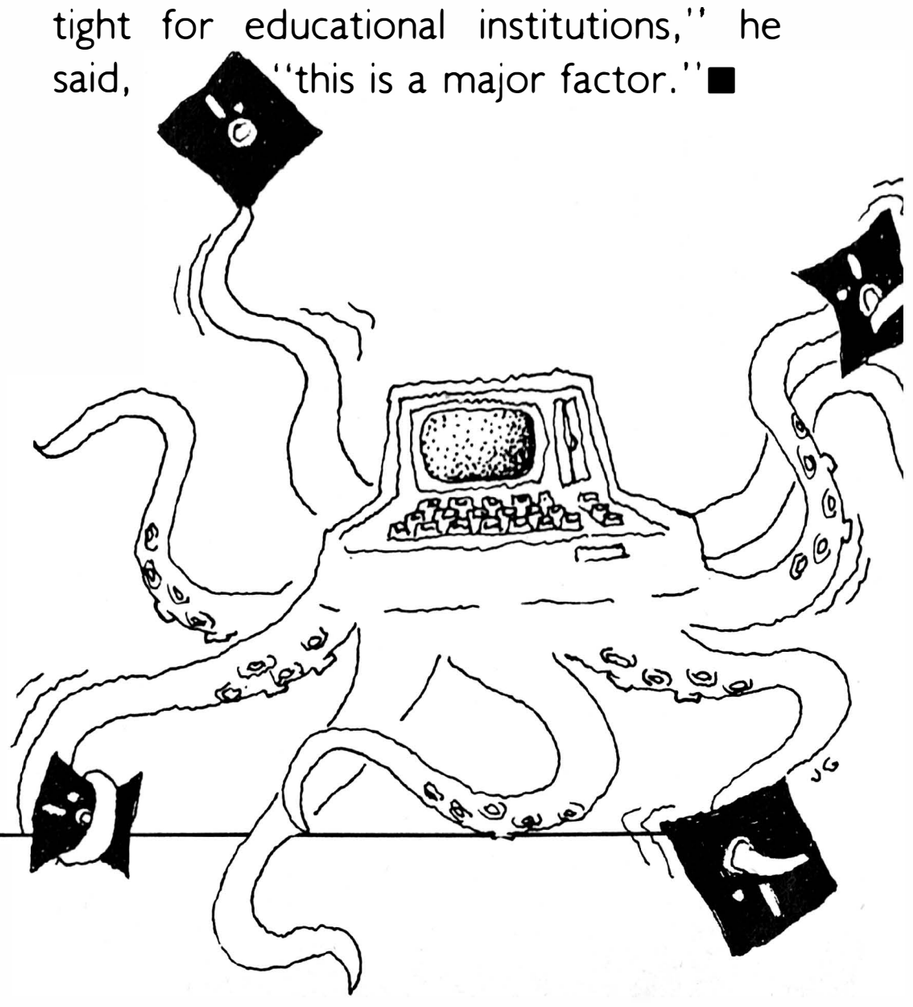
He suggested that educators do a performance audit after the system has been used for six months.

As for selecting a source for the system, "Don't a
cost will be the lowest cost, because frequently it will not be." One reason for this is the matter of warranty maintenance.

"Dealers usually lose money doing warranty maintenance, so they give preference to customers who bought the computer from them. If you bought yours at a discount store, the dealer will probably put you at the end of the line and charge a higher hourly rate for the work."

Gale advised educators to amortize microcomputers over three years. "I know that in three years what I buy today would not be my choice of hardware."

Also, in the educational environment it is important to realize that with small computers you can deal with small incremental changes in order to expand. If you buy one machine each month, no one pays attention. You may spend as much in the long run, but it is a lot easier to slip a small item past your department head or dean than to request $1 million, for example. "In times that are financially tight for educational institutions," he said, "this is a major factor." ■



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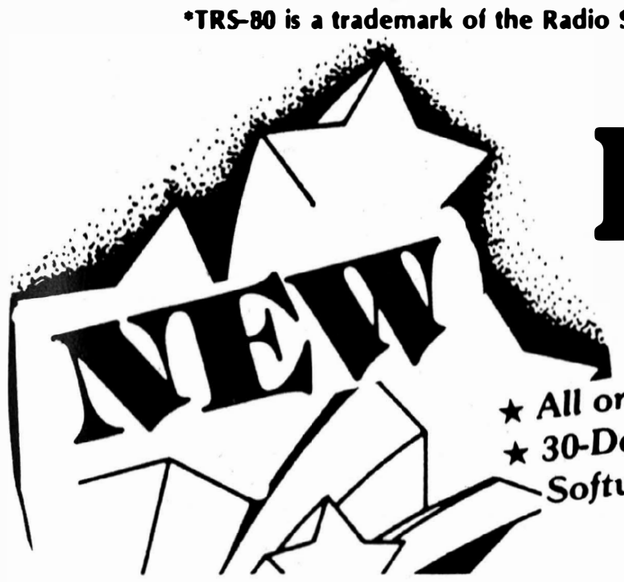

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NAME	DESCRIPTION
1 RULE78	Interest Apportionment by Rule of the 78's
2 ANNU1	Annuity computation program
3 DATE	Time between dates
4 DAYYEAR	Day of year a particular date falls on
5 LEASEINT	Interest rate on lease
6 BREAKEVN	Breakeven analysis
7 DEPRSL	Straightline depreciation
8 DEPRSY	Sum of the digits depreciation
9 DEPRDB	Declining balance depreciation
10 DEPRDDB	Double declining balance depreciation
11 TAXDEP	Cash flow vs. depreciation tables
12 CHECK2	Prints NEBS checks along with daily register
13 CHECKBK1	Checkbook maintenance program
14 MORTGAGE/A	Mortgage amortization table
15 MULTMON	Computes time needed for money to double, triple, etc.
16 SALVAGE	Determines salvage value of an investment
17 RRVARIN	Rate of return on investment with variable inflows
18 RRCONST	Rate of return on investment with constant inflows
19 EFFECT	Effective interest rate of a loan
20 FVAL	Future value of an investment (compound interest)
21 PVAL	Present value of a future amount
22 LOANPAY	Amount of payment on a loan
23 REGWITH	Equal withdrawals from investment to leave 0 over
24 SIMPDISK	Simple discount analysis
25 DATEVAL	Equivalent & nonequivalent dated values for oblig.
26 ANNUDEF	Present value of deferred annuities
27 MARKUP	% Markup analysis for items
28 SINKFUND	Sinking fund amortization program
29 BONDVAL	Value of a bond
30 DEPLETE	Depletion analysis
31 BLACKSH	Black Scholes options analysis
32 STOCVAL1	Expected return on stock via discounts dividends
33 WARVAL	Value of a warrant
34 BONDVAL2	Value of a bond
35 EPSEST	Estimate of future earnings per share for company
36 BETAALPH	Computes alpha and beta variables for stock
37 SHARPE1	Portfolio selection model-i.e. what stocks to hold
38 OPTWRITE	Option writing computations
39 RTVAL	Value of a right
40 EXPVAL	Expected value analysis
41 BAYES	Bayesian decisions
42 VALPRINF	Value of perfect information
43 VALADINF	Value of additional information
44 UTILITY	Derives utility function
45 SIMPLEX	Linear programming solution by simplex method
46 TRANS	Transportation method for linear programming
47 EOQ	Economic order quantity inventory model
48 QUEUE1	Single server queueing (waiting line) model
49 CVP	Cost-volume-profit analysis
50 CONDPROF	Conditional profit tables
51 OPTLOSS	Opportunity loss tables
52 FQUOQ	Fixed quantity economic order quantity model
53 FQEOWSH	As above but with shortages permitted
54 FQEOQPB	As above but with quantity price breaks
55 QUEUECB	Cost-benefit waiting line analysis
56 NCFANAL	Net cash-flow analysis for simple investment
57 PROFIND	Profitability index of a project
58 CAP1	Cap. Asset Pr. Model analysis of project
59 WACC	Weighted average cost of capital
60 COMPBAL	True rate on loan with compensating bal. required
61 DISCBAL	True rate on discounted loan
62 MERGANAL	Merger analysis computations
63 FINRAT	Financial ratios for a firm
64 NPV	Net present value of project
65 PRINDLAS	Laspeyres price index
66 PRINDPA	Paasche price index
67 SEASIND	Constructs seasonal quantity indices for company
68 TIMETR	Time series analysis linear trend
69 TIMEMOV	Time series analysis moving average trend
70 FUPRINF	Future price estimation with inflation
71 MAILPAC	Mailing list system
72 LETWRT	Letter writing system-links with MAILPAC
73 SORT3	Sorts list of names
74 LABEL1	Shipping label maker
75 LABEL2	Name label maker
76 BUSBUD	DOME business bookkeeping system
77 TIMECLCK	Computes weeks total hours from timeclock info.
78 ACCTPAY	In memory accounts payable system-storage permitted
79 INVOICE	Generate invoice on screen and print on printer
80 INVENT2	In memory inventory control system
81 TELDIR	Computerized telephone directory
82 TIMUSAN	Time use analysis
83 ASSIGN	Use of assignment algorithm for optimal job assign.
84 ACCTREC	In memory accounts receivable system-storage ok
85 TERMSPAY	Compares 3 methods of repayment of loans
86 PAYNET	Computes gross pay required for given net
87 SELLPR	Computes selling price for given after tax amount
88 ARBCOMP	Arbitrage computations
89 DEPRSF	Sinking fund depreciation
90 UPSZONE	Finds UPS zones from zip code
91 ENVELOPE	Types envelope including return address
92 AUTOEXP	Automobile expense analysis
93 INSFILE	Insurance policy file
94 PAYROLL2	In memory payroll system
95 DILANAL	Dilution analysis
96 LOANAFFD	Loan amount a borrower can afford
97 RENTPRCH	Purchase price for rental property
98 SALELEAS	Sale-leaseback analysis
99 RRCONVBD	Investor's rate of return on convertable bond
100 PORTVAL9	Stock market portfolio storage-valuation program

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story. For example, when discussing the Mark I, developed jointly by IBM and Howard Aiken of Harvard University in the late 1930s and early 1940s, Bernstein tells us: "What with its relays and other mechanical parts, the Mark I's calculation was audible. As a student at Harvard, I used to drop in now and then and have a look at it. It was situated in a red brick structure just behind the physics building, and when it was working, one could go in and listen to the gentle clicking of the relays, which soun
ladies knitting."

Ever mindful of details, Bernstein does not neglect that vacuum-tube monster, the ENIAC, developed at the University of Pennsylvania. Nor does he omit the EDVAC, EDSAC, and the Univac I.

One item on which Bernstein does skimp is programming languages. More discussion on that subject would have been in order. But, to be fair, he does make it clear that "it is not my purpose here to characterize the ins and outs of the various programming languages." A tidy disclaimer, to be sure.

Bernstein's brief encounter with artificial intelligence is a bit disappointing. He defines the topic and mentions the big names in the field, but he drops the ball there. He writes: "As the term implies, artificial intelligence is the attempt to manufacture entities that people agree are machines but which produce behavior that people agree is intelligent." Wow! Such a statement should provoke some heated debate. I can't help wishing that the author had devoted more time exploring what that means for us—people. Not that Bernstein has the answers, but he might, at the least, have suggested some questions.

All in all, *The Analytical Engine* does its job. After reading it, you'll know a byte from a bit. And the annotated bibliography encourages further reading. Bernstein has tackled a highly technical subject (to put it mildly) and broken it down into understandable parts. The absence of jargon is a relief, and the clarity and conciseness with which Bernstein writes are a delight.

Your Own Computer

by Mitchell Waite and Michael Pardee
Howard W. Sams and Company,
Indianapolis, IN
Second edition, 1981
222 pages, softcover, $7.95
Reviewed by Kathy Abraham

Society is quickly edging toward what Alvin Toffler calls the "electronic cottage," and the small computer is becoming the "hearth" of this cottage. As a result, the market is flooded with books that aim to dispel the aura of mystery surrounding this tool. In the past, most information available to the public was promotional, not educational. Now, however, elementary texts are beginning to surface, but finding a readable, basic computer book is still difficult.

Mitchell Waite and Michael Pardee's *Your Own Computer* doesn't quite fill the bill. The information in this book is solid. A short history of the computer's quick-paced development is traced, a computer vocabulary listing is included, and many types of computers are compared in detail. Each analysis is accompanied by a photograph of the unit. This type of information is valuable for those contemplating buying a computer.

But the back cover of *Your Own Computer* claims the book has been "especially designed to be your first important investment in the personal-computer field, providing the beginner with the knowledge and confidence to utilize this marvel of our time." Beginners beware! The book never makes good on this claim. Except for a few chapters that extol the wonders of the computer, the writing is above the beginner level.

The authors suggest that there are only two types of computer users: the "deep" hobbyist, who loves to take computers apart, and the "surface" game player, who could care less about computer intricacies. The range of subject matter clearly indicates an attempt to appease both types. In doing so, Waite and Pardee shamefully neglect those newcomers who are genuinely interested in discovering what makes the machine work. Their explanations on computer language and functions tend to get bogged down in scientific gobbledygook. This will turn off many readers who have little science or math background.

Your Own Computer is educational and worth reading, but be sure to pass grade one in computer literacy before you attempt it.

The Devil's DP Dictionary

by Stan Kelly-Bootle
McGraw-Hill Book Company
New York, 1981
141 pages, softcover, $7.50
Reviewed by Rachael Wrege

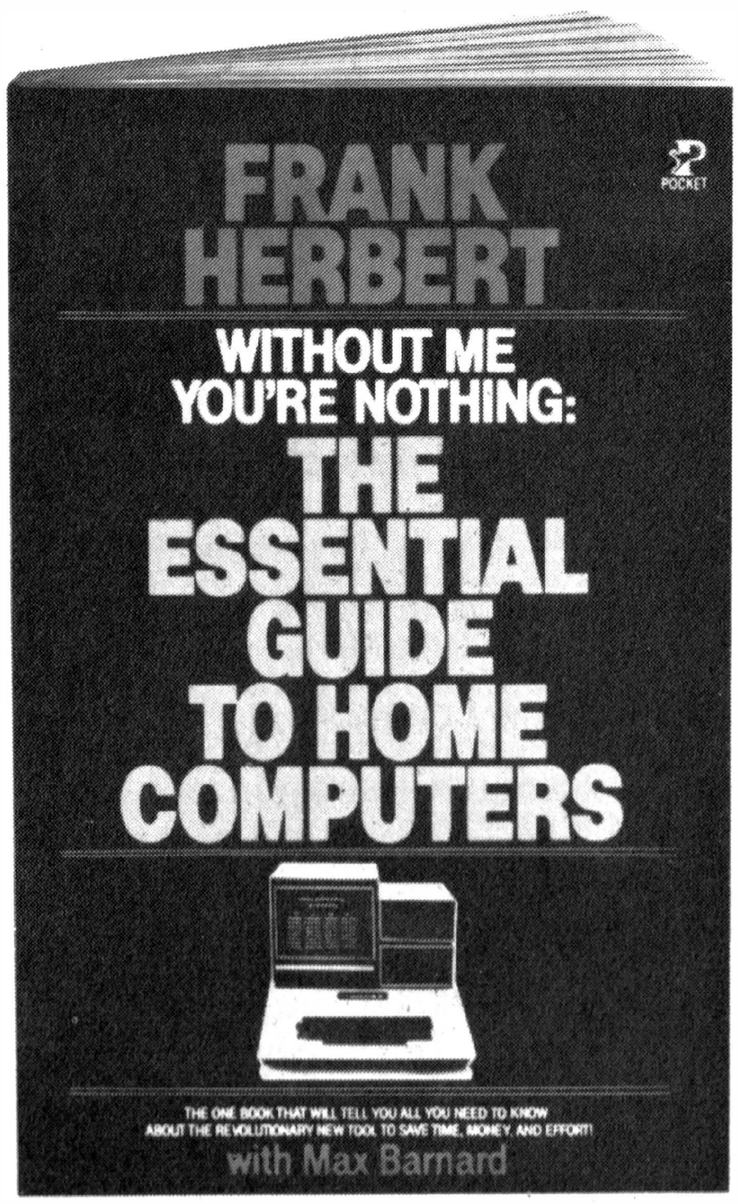
The Devil's DP Dictionary is a hilarious collection of data processing jargon designed to send computer programmers, operators, and other DP pros into fits of hysterical giggling.

Author Stan Kelly-Bootle says his book "casts an amusing glare on the many linguistic opacities which bedevil the computing trade." So punch up a continuous loop, pull up a comfortable chair, and chuckle along with such definitions as:

> **random file** *noun: a place where things can get lost in any sequence*
> **Terminal Diseases, Inc.** *: an international company devoted to performing post mortems on dead terminals. The company's computerized service and diagnostic center is linked to most of the large commercial networks, whence the proud slogan, "If you can reach us, you don't need us."*

Although *The Devil's DP Dictionary* is written for readers who understand the difference between a bug and a glitch, non-DP types will find the book guffaw-provoking as well. It's an essential item for any computer fishbowl, especially to avoid an **abend** (which Kelly-Bootle defines as "a system abort deliberately induced, usually on Fridays, to allow the third shift staff to leave early").

Be good to yourself. Make someone buy you *The Devil's DP Dictionary* for Christmas. ■



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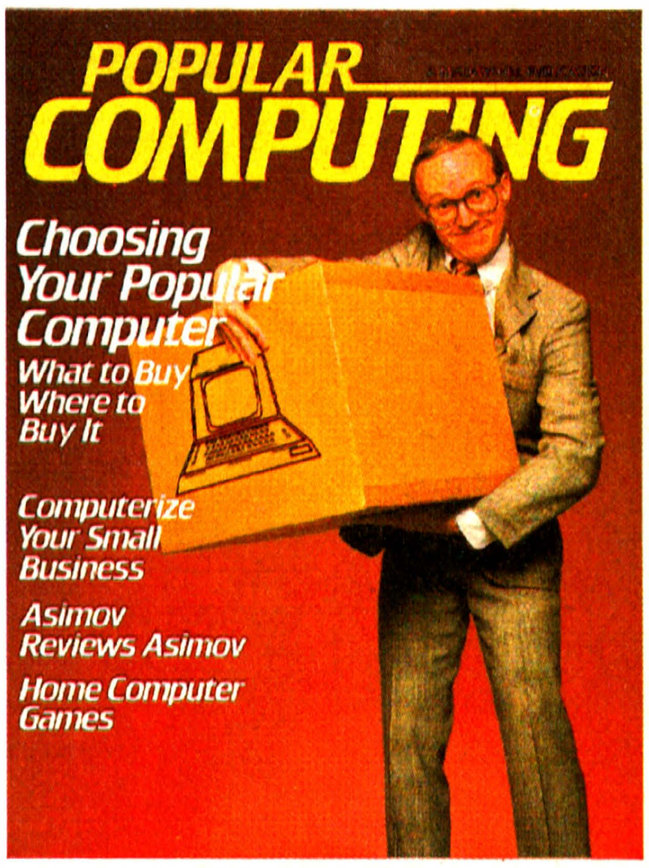

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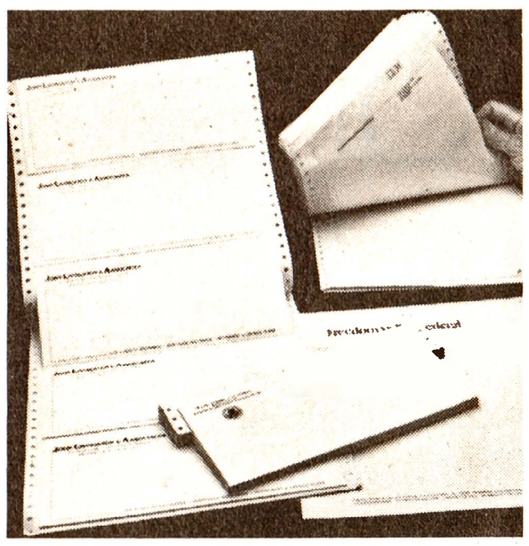

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Juggling on an Apple

Word Juggler is a word-processing program that makes full use of the upper- and lowercase keyboard, 80-column display, and large memory capacity of the Apple III. Word Juggler is facilitated by keyboard templates for the command keys, virtually eliminating the need to refer to a manual or reference card. A variety of editing functions such as delete word, delete to end of line and delete to end of paragraph, as well as search and replace, and block load, store, and delete, are included. Word Juggler also lets you print multiple copies or specific pages. Bold printing and underlining are supported as well as superscripting and subscripting. The program is priced at $295 from Quark Engineering, 1433 Williams, Suite 1102, Denver, CO 80218, (303) 399-1096.

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Educational Courseware Catalog

Listings of educational courseware (software and course materials) for elementary and secondary schools, programs on computer literacy, mathematics, language arts, BASIC programming, administrative needs, and more are included in a catalog from the Microcomputer Division, J. L. Hammett Co., Hammett Pl., POB 545, Braintree, MA 02184.

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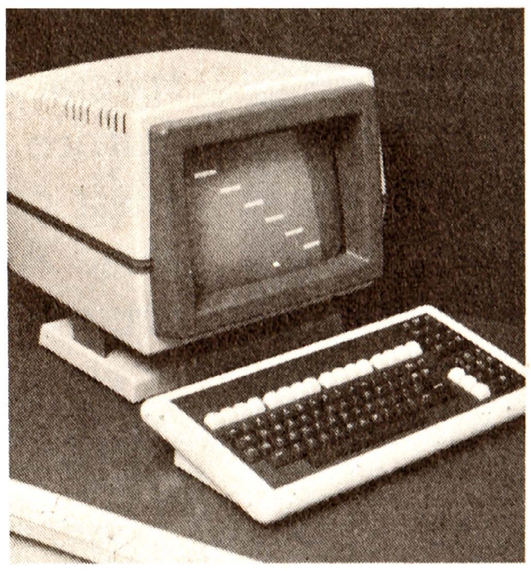

A Microcomputer from ISM

ISM (International Systems Marketing) has announced the Intersystem Model 40, a business and word-processing system for office or home use. The Model 40 features 64 K bytes of programmable memory, a keyboard, 12-inch video display, and two 5-inch floppy-disk drives with a total of 2 megabytes of storage. Peripherals can be attached with one RS-232C serial and one parallel port. The CP/M operating system is standard. The Model 40 costs about $4195, and other models (the 10, 20, and 30 are available) range from $2295 to $3595, depending on configuration. Contact ISM, 5161 River Rd., Bldg. 20, Bethesda, MD 20016, (301) 986-0773.

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Apple Security Schemes

The Soft Key system is a hardware-oriented antipiracy system for Apple software. Programmers can create their own security schemes with a custom program embodied in a non-copyable "key." Actually a custom integrated circuit with software, the key is plugged into a master security board to create protection unique to the particular program. The master board plugs into the Apple and is available in 1-, 8-, or 16-key versions, allowing the protection keys for several programs to co-reside in the computer. The protection key can be used to safeguard floppy disks, hard disks, and computer-network software. Programs written in Applesoft, Integer BASIC, Pascal, FORTRAN, and the various languages used in conjunction with the Microsoft Softcard can all be protected by the Soft Key system.

Soft Key Associates, Inc., charges an initial fee to instruct programmers in techniques, although for the wary among us, specific program details need not be disclosed even to the company. Cost is approximately $18 to OEMs (original equipment manufacturers) for a single keyboard with one custom key. Contact Soft Key Associates, Inc., 44 Front St., Ashland, MA 01721.

Circle 205 on inquiry card.

Big Little SuperPET

The SuperPET is a microcomputer that thinks big. Based on the Model 8032 from Commodore Business Machines, the microcomputer features a 12-inch video display, standard typewriter keyboard with upper- and lowercase characters, and a numeric keypad. The SuperPET uses a 6809 microprocessor with 36 K bytes of ROM (read-only memory), 96 K bytes of programmable memory, and supports all current Commodore peripherals except the C2N cassette recorder. The computer also allows an RS-232C interface to work at speeds of up to 9600 bps (bits per second). Another plus is the SuperPET's ability to work with mainframe computers. The SuperPET currently uses Waterloo microBASIC, microPascal, microFORTRAN, and microAPL and costs $1995. Contact Commodore Business Machines, 681 Moore Rd., King of Prussia, PA 19406, (215) 337-7100.

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Manage Your Money with a Microcomputer

The Personal Check Manager runs on an Apple II with 48 K bytes of main memory and allows you to enter checks and deposits, and keep track of automatic payments. Sorting all entries automatically, the checkbook program lists entries in chronological order and delivers a daily balance. The program will also list check payees, provide an end balance, search any field, delete any entry, and code checks. The Personal Check Manager program costs $30 and is available from D. R. Poling, 6929 La Cienega Blvd., Los Angeles, CA 90045.

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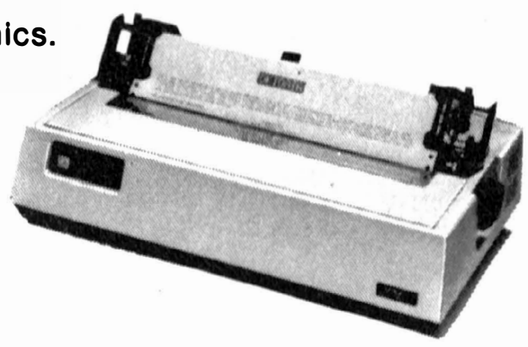

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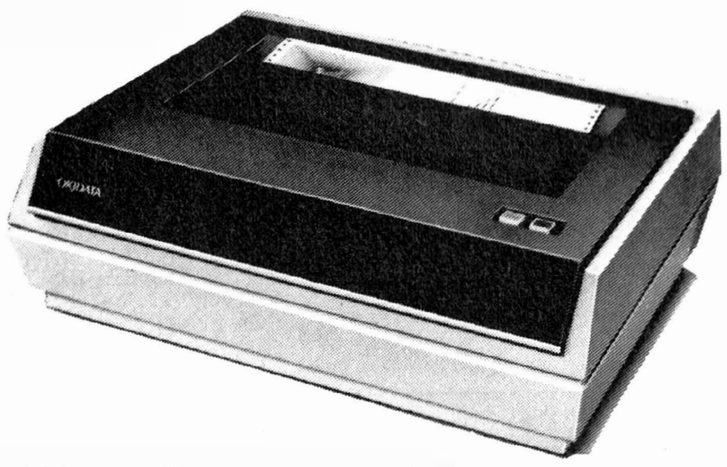

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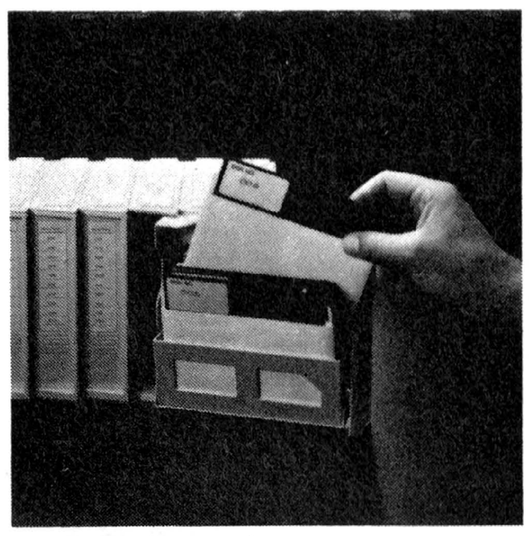

Safety First

Keep your floppy disks in order and good repair with the DiskBank System, a modular storage and filing system for floppy disks. DiskBank Systems can be interlocked or stacked together, thereby allowing users to structure the system according to space constraints. Each DiskBank holds ten 5- or 8-inch disks. The DiskBank is manufactured by Amaray Sales Corp., 2251 Grant Rd., Suite H, Los Altos, CA 94022, (415) 968-2840.
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Individualized Learning Letter

"No superintendent, principal, supervisor, or college library patron should be unaware of the time and money saved by investing in microcomputer hardware and software," says *The Individualized Learning Letter*. The *Letter* features articles, news reports, new products, and other attractions for educators. It is published 13 times a year, and there are three special issues. A one-year subscription to *The Individualized Learning Letter* is $45 from Two Star Systems, Inc., 10 Park Pl., Suite 235, Morristown, NJ 07960, (201) 267-0737.
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Come to the County Carnival!

Welcome to County Carnival, a fast-moving shooting gallery game with multicolor animation and carnival sound effects. As you try to shoot targets with a limited number of bullets, a vicious duck attacks your ammunition if you're not quick enough! The target rabbits multiply at a faster and faster rate as the game goes on, but you can win bonus rounds and gain points by hitting bouncing, flying, and covered targets. You can test your shooting skills in County Carnival with an Apple II or II Plus. The game is priced at $24.95 from Programma International, Inc., 2908 N. Naomi St., Burbank, CA 91504, (213) 954-0240. The game requires a floppy-disk drive and game paddles or a joystick.
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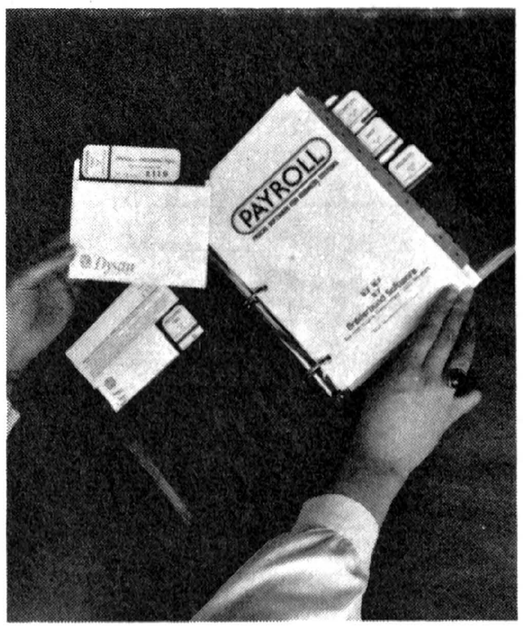

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The Run Time Payroll program can prepare any payroll on an Apple II equipped with Apple Computer Inc.'s Run Time module. This module allows programs written in Pascal to be run on an Apple II with the DOS 3.3 operating system without a special language card. Run Time Payroll can handle 300 employees, 15 divisions, and 30 deduction types, and compute federal and state income taxes plus other state and local taxes. Checks, W-2 forms, quarterly and sum-

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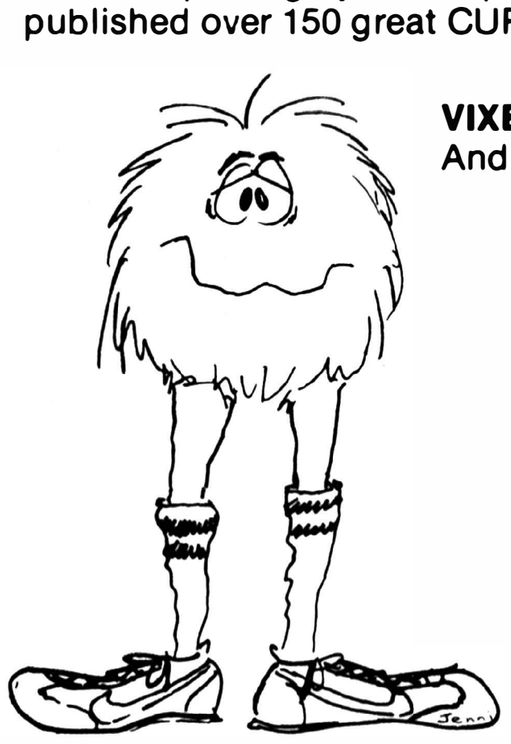

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If you own an Apple™ or are thinking of owning one, here is what you should know about Super-Text™!

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New Products

mary reports, and related items can be printed. The $395 payroll program requires an Apple II with two disk drives and is available from Broderbund Software, POB 3266, Eugene, OR 97405, (503) 343-9024.

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Mercator Business Systems Brochure

Presenting computer systems for medicine, business, law, accounting and other professional firms, Mercator Business Systems's new brochure describes its family of small-business-computer systems. All Mercator products are designed to be compatible with Basic Four Corporation computers and products for future expansion. The brochure is free from Mercator Business Systems, 1294 Lawrence Station Rd., Sunnyvale, CA 94086, (408) 734-5134.

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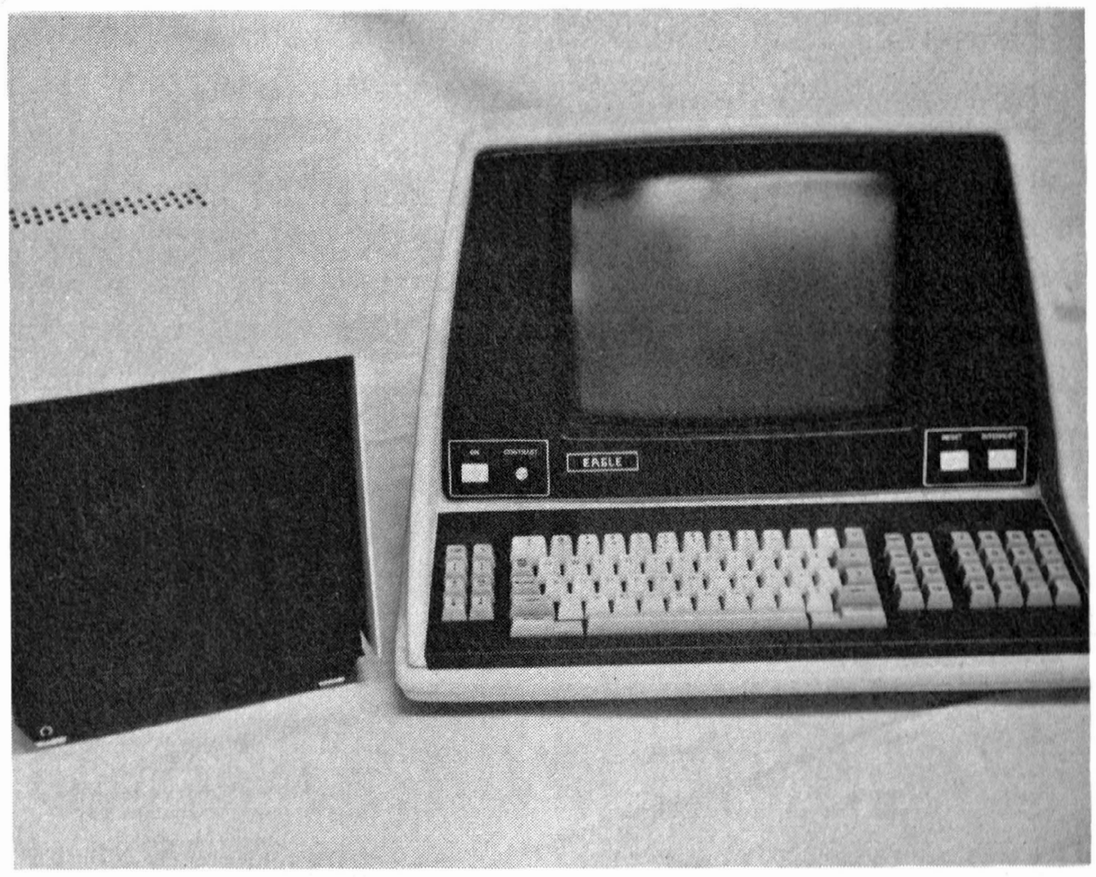

A Maxi-Micro from Computhink

The Eagle 32 family of microcomputers consists of the Models 10 and 20, which use the 68000 16-bit microprocessor. Each computer has 128 K bytes of programmable memory. Using ultra-high-density recording techniques, the Model 10 can store a maximum of 3.2 megabytes using two 5-inch floppy-disk drives, and the Model 20 can store 4.8 megabytes using two 8-inch drives. Both systems are expandable to 1 megabyte of main memory (RAM).

The Eagle 32 family can be used for commercial or scientific applications and initial deliveries will include a batch operating system (one that takes a series of programs and runs them, one by one, until all are finished), BASIC+, Tiny FORTRAN, and FORTH+. Available aids for the system include program documentation tools, source editing tools, program debugging tools, and a program linking loader to allow intermixing of languages. The Eagle 32 series comes with 80-line by 24-character video displays with reverse video. Medium-resolution graphics, a graphics character set, and choice of video-display layouts are some of the options. The Model 10 is priced at $6650 and the Model 20 goes for $7650 from Computhink, 965 W. Maude Ave., Sunnyvale, CA 94086, (408) 245-4033.

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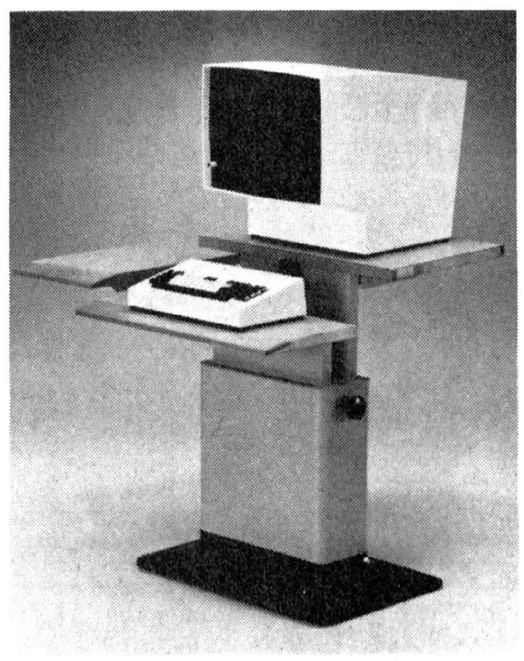

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Developed for the ergonomic (physical and psychological) safety and comfort of data-entry operators, the RH-System furniture line includes workstations engineered for comfort and efficiency. The key piece in the RH-System is a table that allows adjustment in the position of keyboard, screen, and source materials. The RH-System also includes worktables and portable document files that can be combined to form a larger workstation. For more information, contact Data Furniture, Inc., 5775 Wayzata Blvd., Suite 840, Minneapolis, MN 55416, (612) 541-9542.

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So You Want to Learn to Program?

Programs for Beginners on the TRS-80, by Fred Blechman, is aimed at the computer novice intrigued with the ins and outs of the TRS-80. Providing instruction through 21 programs, the lessons include a five-dog race, bingo, an on-screen digital clock, simple business programs, a magic square number calculator, and more. Appendices include a video-display worksheet, cassette loading time charts for Level I and Level II, and a description, schematic, and parts list for an audio/visual control box. *Programs for Beginners on the TRS-80* is priced at $8.95. It's also available on Model I Level II or Model III BASIC cassette for $10.95, from the Hayden Book Co., Inc., 50 Essex St., Rochelle Park, NJ 07662, (800) 631-0856; in New Jersey (201) 843-0550.

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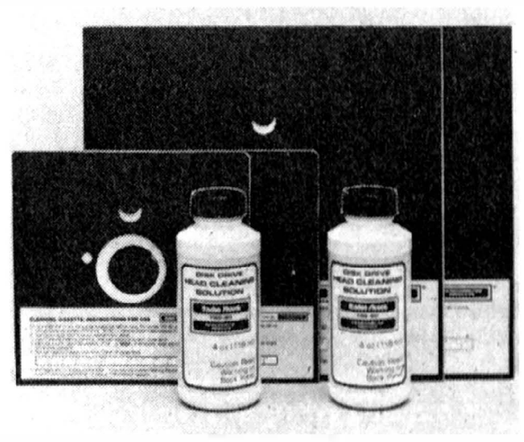

Keep Those Disk Heads Clean!

Disk-drive head-cleaning kits for routine cleaning and maintenance of TRS-80 disk drives are now available from Radio Shack. Kits for 5- and 8-inch drives include two cleaning disks, a bottle of head-cleaning solution, and complete instructions. The kits are available for $29.95 at Radio Shack stores, Computer Centers, and participating dealers. Contact Radio Shack, 1800 One Tandy Center, Fort Worth, TX 76102, (817) 390-3272 for more information.

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Microinv

The Compumax Microinv Inventory Control program for small businesses requires an Atari 800 with two disk drives, a 40- or 80-column printer, and 32 K bytes of main memory. Microinv is designed for computer neophytes and requires only a basic knowledge of bookkeeping practices and microcomputer operation.

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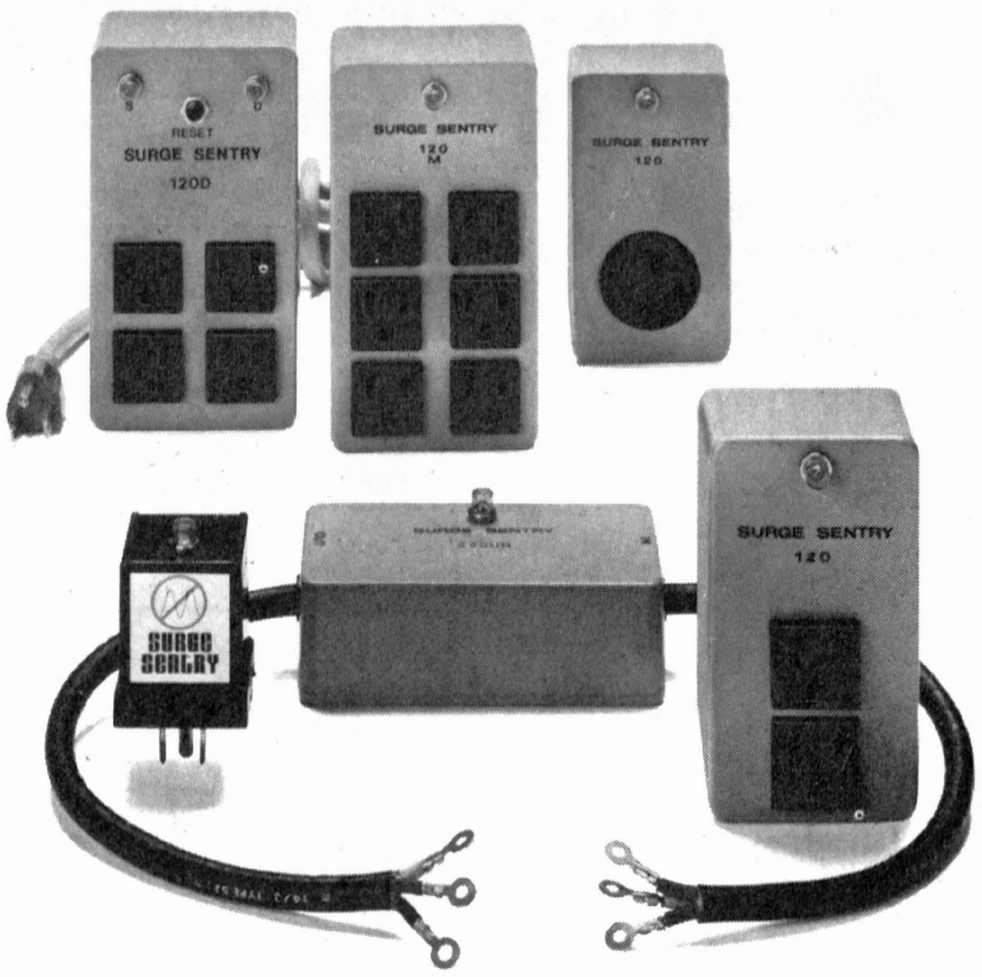

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New Products

The program's master file sorts and maintains items by stock number and provides data on part number, description, vendor number, quantity on hand, quantity on order, sale price, current cost, average cost, units used, reorder point, and more. The transaction file maintains data on sales, orders, and delivery activity on items contained in the master file. Reorder, stock status, single item, job cost, and vendor reports are generated by the program. Microinv costs $140 and is available from Compumax Assoicates, POB 1139, Palo Alto, CA 94302, (415) 321-2881.

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Letter Perfect for the Atari

A word-processing program for the Atari 800, Letter Perfect spaces letters properly, numbers pages, and underlines characters. The program can print characters closer together, shrink and enlarge, move blocks of text, scroll forward and back, set tabs, and insert or delete characters and lines. Authors can edit, merge, print, lock and unlock files, and use data-base merging for mailings. Printing and video screen formats are programmable. Letter Perfect is available from LJK Enterprise, Inc., POB 10827, St. Louis, MO 63129, (314) 846-6124.

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The BASIC Handbook

The BASIC Handbook, Second Edition: An Encyclopedia of the BASIC Computer Language, defines over 500 critical BASIC terms and their functions. It also describes strategies and programs to convert BASIC words from one system to another. The handy reference guide was written by Dr. David A. Lien and is available for $19.95 from Compu-Soft Publishing, 1050–E, Pioneer Way, El Cajon, CA 92020, (714) 588-0996.

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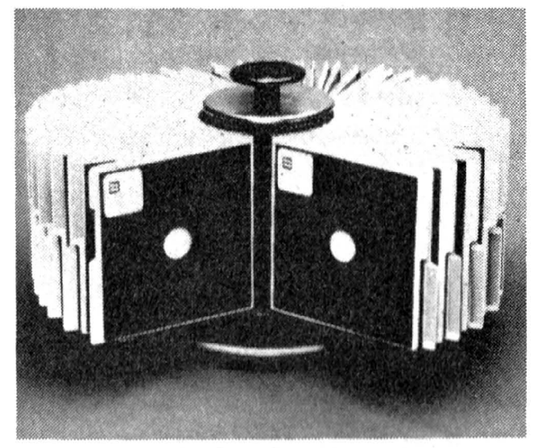

Store Disks Safely

The DR series Rotary Stand safely stores 150 floppy disks in 75 vinyl files. Each file is heat-sealed rather than glued to prevent chemical damage. The plastic dividers keep disks rigid, eliminating warping and bending. Files rotate on a weighted base and provide full title visibility. The filing system and other accessories are available from Pacific Media Products, 1205 E. Cypress, Lompoc, CA 93436, (805) 736-7087.

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Apple III Learns to Type

Now available for the Apple III is Type-Righter, a word-processing program featuring simplified command functions and the ability to see on the screen exactly what your printed document will look like. Other features include automatic justification as text is entered, global search and replacement of words and phrases, adjustable tabs, automatic envelope addressing, and individual line centering. The program is available for $195 from Imagineering Inc., c/o Adcast Advertising, 405 S. Farwell, Suite 10, Eau Claire, WI 54701, (715) 835-8611.

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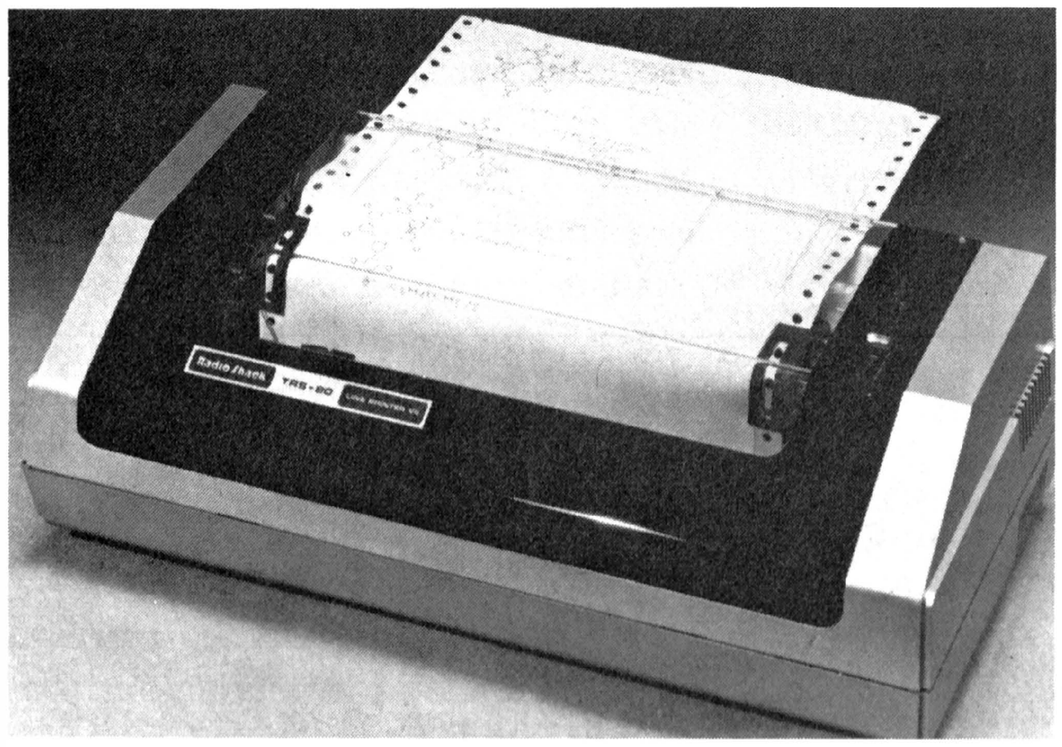

Line Printer VII

Welcome to the emerging world of inexpensive printers! The Line Printer VII offers impact printing and high-density graphics, prints 80 or 40 upper- and lowercase characters per line at 30 cps (characters per second), and can produce printouts similar to the display on the TRS-80 Color Computer. In fact, a program to print whatever is shown on the screen, such as graphics, is available for the LP VII and the Color Computer. LP VII uses continuous form paper and includes switch-selectable parallel and serial interface options. Price for the Line Printer VII is $399 from Radio Shack, 1800 One Tandy Center, Fort Worth, TX 76102, (817) 390-3272.

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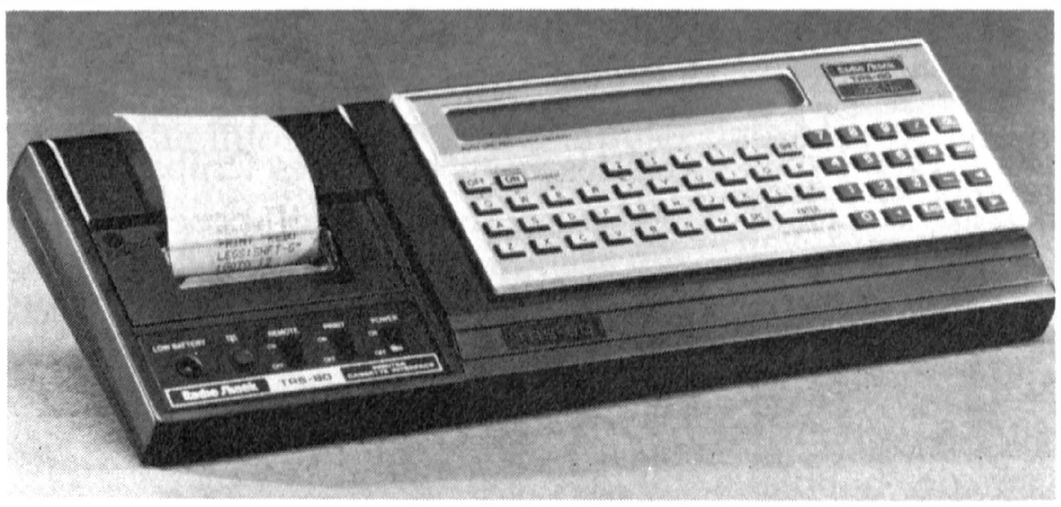

Hard Copy for the Pocket Computer

A printer and cassete interface for the TRS-80 Pocket Computer is now available at Radio Shack stores, Computer Centers and participating dealers. The $149.95 unit comes with rechargeable batteries, an AC adapter/charger, cassette-recorder connecting cable, printer ribbon, three rolls of paper, and a manual. The interface attaches easily to the side of the computer, and the printer provides 16-character-per-line printouts of programs and data on ordinary electronic cash register paper. With the cassette interface, programs and data can be loaded, saved, and recalled using an ordinary cassette tape recorder. A handy indicator alerts users to low batteries. For more information, contact Radio Shack, 1800 One Tandy Center, Fort Worth, TX 76102, (817) 390-3272.

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In Other Words

We chose some of the most common computing terms to include in this glossary.

acoustic coupler: A mechanical device that allows a telephone handset to be connected to a modem (see **modem**). The term is sometimes used to refer to the entire modem.

address: A way of identifying any location in the memory of a computer.

application program: Software designed for a specific purpose (such as accounts payable or receivable, payroll, inventory, etc.).

artificial intelligence: A specialized field of research in computer science. The term refers to the ability of a computer to perform functions normally carried out by the human brain (such as reasoning and learning).

ASCII: The American Standard Code for Information Interchange. The most generally used format for representing and exchanging textual information among computers. Under the code, each of 96 characters (letters, numbers, and symbols) is given a unique binary number code (1s and 0s).

assembly language: A means of communicating with a computer at a low level. Assembly language lies between high-level languages (such as BASIC and Pascal) and machine language (the 1s and 0s the computer understands at its most basic level). Programmers use assembly language to make efficient use of memory space and to create a program that runs quickly.

backup: An extra copy of software, normally kept on file in case the original program is damaged or lost.

BASIC: Beginner's All-purpose Symbolic Instruction Code. The most used high-level language for small computers.

baud: A measure of the speed at which data travels (normally between a computer and a peripheral or between two computers).

binary: A numbering system that uses only 1s and 0s. It is an efficient way of storing information in a computer since the hundreds of thousands of microscopic switches in the computer can only be on (1) or off (0).

bit: A binary digit (1 or 0).

bootstrap: A piece of software, usually stored permanently in memory, that activates other pieces of software in order to bring the computer from "off" into readiness for use.

bps: Bits per second. A measure of data-transmission speed showing the number of bits of information that pass a given point in one second. In small computers, the most common bps used is 300.

break: An interruption of a transmission. Most small computer keyboards have a Break key that tells the computer to stop what it's doing and wait for further instructions.

bubble memory: A new method of storing information for a computer using microscopic magnetic bubbles. Although the technology was developed almost a decade ago, it is still expensive and not yet generally available for small computers.

buffer: An area in the computer's memory used to temporarily store information. When using a printer, a buffer is needed because the printer operates much more slowly than the computer.

byte: A sequence of bits that represents a single character. In most small computers, a byte is eight bits.

CAD/CAM: Computer-Aided Design/Computer-Aided Manufacturing. CAD/CAM is normally done on large computers because large amounts of memory and processing power are required.

CAI: Computer-Aided Instruction. Computers used to teach normally involve a two-way "conversation" between the student and the computer; the computer informs the student of mistakes as he makes them, and is able to respond to the student's demonstrated lack of knowledge.

channel: A path for the transmission of information between two points.

character: A single letter, number, or other symbol. In a small computer, a character is normally represented by eight bits (one byte).

chip: A generic term for an integrated circuit (IC), a single package holding hundreds or thousands of microscopic electronic components. The term comes from the slices (chips) of silicon of which they are composed.

clock: In a small computer, a repeating signal (usually in the range of millions of cycles per second) that controls the microprocessor "brain." Each time the clock sends a pulse, the computer performs a single task.

command: A word or character that causes a computer to do something.

compiler: A piece of software that takes a series of commands written in a high-level language and translates them into a lower-level language more efficient for the computer to use.

computer network: Two or more connected computers that have the ability to exchange information.

computer program: A series of commands, instructions, or statements put together in a way that tells a computer

to do a specific thing or series of things.

core memory: An outdated term for the main memory of a computer. Although core memory has been replaced by semiconductor memory, the term is often used to represent main memory.

CP/M: Control Program for Microprocessors. One of the oldest and most popular *operating systems* for small computers. An operating system is a group of programs that is often compared to a traffic cop because it actually controls what the computer is doing by acting as an intermediary between the hardware and the software. Any piece of applications software must be written for a specific operating system. CP/M was introduced in 1975 and has become one of the most popular operating systems; an estimated 250,000 small computers use it. Thousands of specialized application programs have been written to be used with CP/M.

CPU: Central processing unit. The heart of a computer that controls all operations of all parts of the computer and does the actual calculations.

CRT: Cathode-ray tube. A TV-like display used with most small computers to show the information the computer has output.

cursor: A position indicator on a CRT. It's normally a flashing or nonflashing square or rectangle.

data: A general term meaning any and all information, facts, numbers, letters, symbols, etc., which can be acted on or produced by a computer.

data base: A collection of related data that can be retrieved by a computer (such as a mailing list or list of accounts).

debug: To go through a program to remove mistakes.

diagnostic: A specialized program that checks the computer for problems and tries to isolate any problems that it finds.

disk: A round piece of magnetic-coated material used to store data with greater density, speed, and reliability than is available on cassettes (see **floppy disk**).

diskette: See **disk**.

display: A method of representing information in visible form. The most common displays used with popular computers are CRTs and printed paper.

documentation: (1) The instruction manual for a piece of hardware or software. (2) The process of gathering information while writing a computer program so that others using the program are able to see what was done.

downtime: Any period of time when the computer is not available or not working.

dump: To copy all information available from one form of storage to another.

edit: To modify or add data to an existing document or program.

emulation: A process by which some computers can run programs not specifically written for them.

execute: To carry out an instruction or series of instructions.

firmware: A term referring to software that has been permanently placed in memory – usually into a ROM (read-only memory).

floppy disk: A disk storage device made from a thin, circular piece of magnetic material. The usual disk sizes used with small computers are 5¼ inch and 8 inch.

flowchart: A common method of graphically planning what a piece of software should do before the actual writing process begins, or for describing what it does after it is written.

FORTRAN: FORmula TRANslation. A high-level computer language used primarily for mathematical computations. Although FORTRAN is available for some small computers, it is mainly used with large commercial systems.

garbage: Meaningless information.

graphics: Pictorial information in two dimensions.

hard copy: A printout of information produced by the computer.

hardware: The physical part of the computer (such as the CRT, CPU, memory, etc.), as opposed to software.

hexadecimal: A number system with the base of 16. It is commonly used by programmers to indicate locations and contents of a computer's memory.

high-level language: A method of programming that allows a person to give instructions to a computer in a form using letters, symbols, or English-like text, rather than in the 1s and 0s code which the computer understands.

impact printer: A printer that produces hard copy by physically striking a ribbon and paper.

input: The transfer of data into the computer.

input/output: Called I/O for short, this is a general term for the equipment (such as modem or printer) connected to a computer and the two-way exchange of information that goes on between the computer and the peripheral.

instruction: A command to the computer telling it to do one specific thing.

integrated circuit: Also known as a chip, this is a group of interrelated circuits in a single package.

interactive: Describes a computer system where a two-way conversation goes on between the user and the computer.

interface: A piece of hardware or software used to connect two devices (computers and peripherals) that cannot be directly hooked together.

interpreter: A computer program which translates a single line of a high-level language at a time for the computer. Interpreters are more convenient but less efficient than compilers.

iteration: A series of steps in a program that is repeated until a condition is satisfied. (Also called a loop).

line printer: A type of high-speed computer printer that prints an entire line at a time (instead of a character at a time).

load: To put data and/or programs into a computer.

location: A single specific place within computer memory where a piece of data is stored. A location is usually identified by a number (known as an address).

LSI: Large-scale integration. A single integrated circuit which has more than 100,000 circuits on it.

machine language: The "native language" of a computer; those fundamental instructions the machine is capable of recognizing and executing. The instructions are represented by binary code (1s and 0s).

memory: Circuitry and devices that hold the binary 1s and 0s the computer can access. Examples are main memory (integrated circuits), floppy disks, cassette tape, etc.

microprocessor: The central processing unit of a computer (usually in a single integrated circuit) that holds all the elements for manipulating data and performing arithmetic calculations.

MIS: Management information system. The use of a computer for providing information useful to managers (such as inventories, sales, accounts payable and receivable, etc.).

modem: Short for MOdulator/-DEModulator. An electronic device that allows computer equipment to send and receive information through telephone lines. There are two major types: direct-connect modems and acoustic couplers. Direct-connect modems usually plug directly into a telephone wall jack; acoustic couplers use the telephone handset for sending and receiving information.

network: An interconnected system of computers and/or terminals. The components do not have to be physically close to one another and are often connected by telephone lines.

node: A station on a network. A node can be a computer or terminal.

operating system: "Traffic cop" software that oversees the overall operation of a computer system.

Pascal: A high-level programming language named after the seventeenth-century French mathematician Blaise Pascal.

peripherals: Equipment (usually hardware) that is external to the computer itself. The most common peripherals used with popular computers are disk drives, printers, and cassette-tape recorders.

printer: An output device that produces hard copy.

printout: Hard copy produced by a printer.

program: (1) A set of instructions that tell a computer to do something. (2) To prepare the set of instructions.

RAM: Random-access memory. The main type of memory used in a small computer. The time required for the computer to find one piece of information in RAM is essentially the same no matter where the information is stored. Also known as read/write memory because data in RAM can be easily changed.

ROM: Read-only memory. Memory where information is permanently stored and cannot be altered. This form of memory is also random-access.

RS-232C: A technical specification published by the Electronic Industries Association which specifies one way in which a computer communicates with a peripheral (such as a modem or terminal).

service contract: A repair contract. Computer failure insurance.

software: Programs or segments of programs. The term was coined to contrast with hardware—the actual mechanics and circuitry of a computer.

software house: A company that writes programs or customizes programs specifically to the needs of an individual customer.

system: An organized collection of hardware and software that works together.

system software: General-purpose programs that allow programmers to write or modify applications programs. BASIC may be considered part of the system software; so is the computer's operating system.

telecommunication: Transmission of data between a computer and another computer or terminal in a different location. It can be done with phone lines, satellites, radio waves, optical fibers, or other means.

terminal: A piece of equipment with a keyboard for input and an output device such as a CRT or printer. A terminal is used to communicate with the computer.

timesharing: A process whereby the facilities of a single (usually large) computer are shared by a number of users. Timesharing requires large amounts of memory and special software to make it appear that each user has the whole computer to himself.

track: A section of a disk or tape.

turnkey system: A computer system in which all the hardware and software has been installed. Theoretically, all you have to do is turn it on.

volatile memory: Hardware which requires continuous electrical power to keep from losing information. Most RAM is volatile; ROM is not.

word: A group of characters or data that occupies one location in the computer's memory.

word processing: The entry, manipulation, editing, and storage of text using a computer.

3 ALTERNATIVE INTERFACES FOR THE TRS-80

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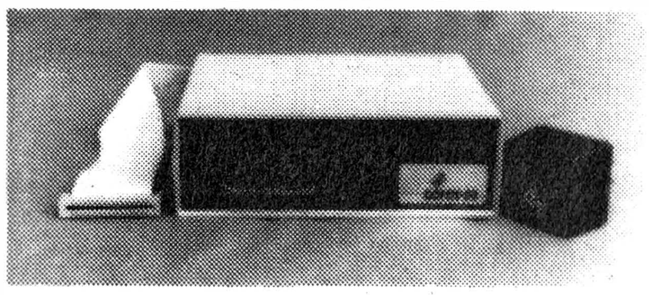

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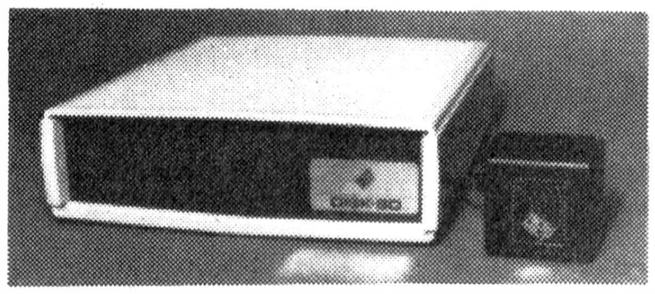

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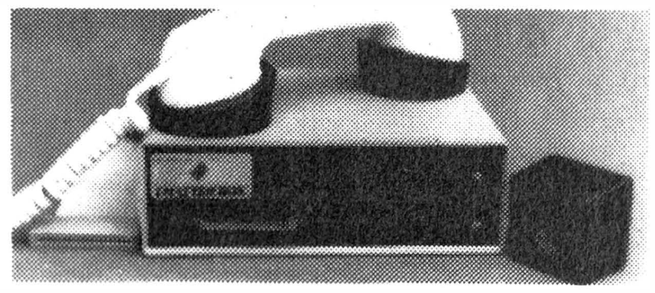

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Coming Up

The Four Top-Selling Small Computers—How the Apple II, Atari 800, Commodore PET, and TRS-80 Model III compare. Plus a look at the best-selling Japanese personal computer.

A Beginner's Guide to BASIC—A step-by-step tutorial on how to start writing your own programs.

Chip Manufacturing—A fascinating look at how sand is turned into the tiny integrated circuits that are the brains of modern computers.

High-Tech Fears—A new psychic disorder, computerphobia, is making some people miserable. If you're among the sufferers, find out what you can do about it.

The Computerized Car: Fact or Science Fiction?—Thanks to small-computer technology, Detroit may soon be building more efficient cars.

Computer-Assisted Betting—Can a personal computer turn the odds to your advantage? The programmers say yes; professional bookmakers say no.

Plus Reviews:

VisiDex, VisiPlot, VisiTrend, and VisiTerm—Four new software packages from the people who brought you VisiCalc.

Computerized Othello—Guaranteed to drive you nuts, this new version of an "old standard" combines the best of checkers and chess.

Zork—Some call it the ultimate adventure game; others call it sheer madness.

New Columns

Small-Business Computing by Steve Ditlea—Things you should know in order to use a small computer to save money in your business.

What Do You Do After You Plug It In? by Bill Barden—Everything you wanted to know about using small computers.

Plus the Glossary, Ask Popular, My Computer Likes Me, and other regular features.

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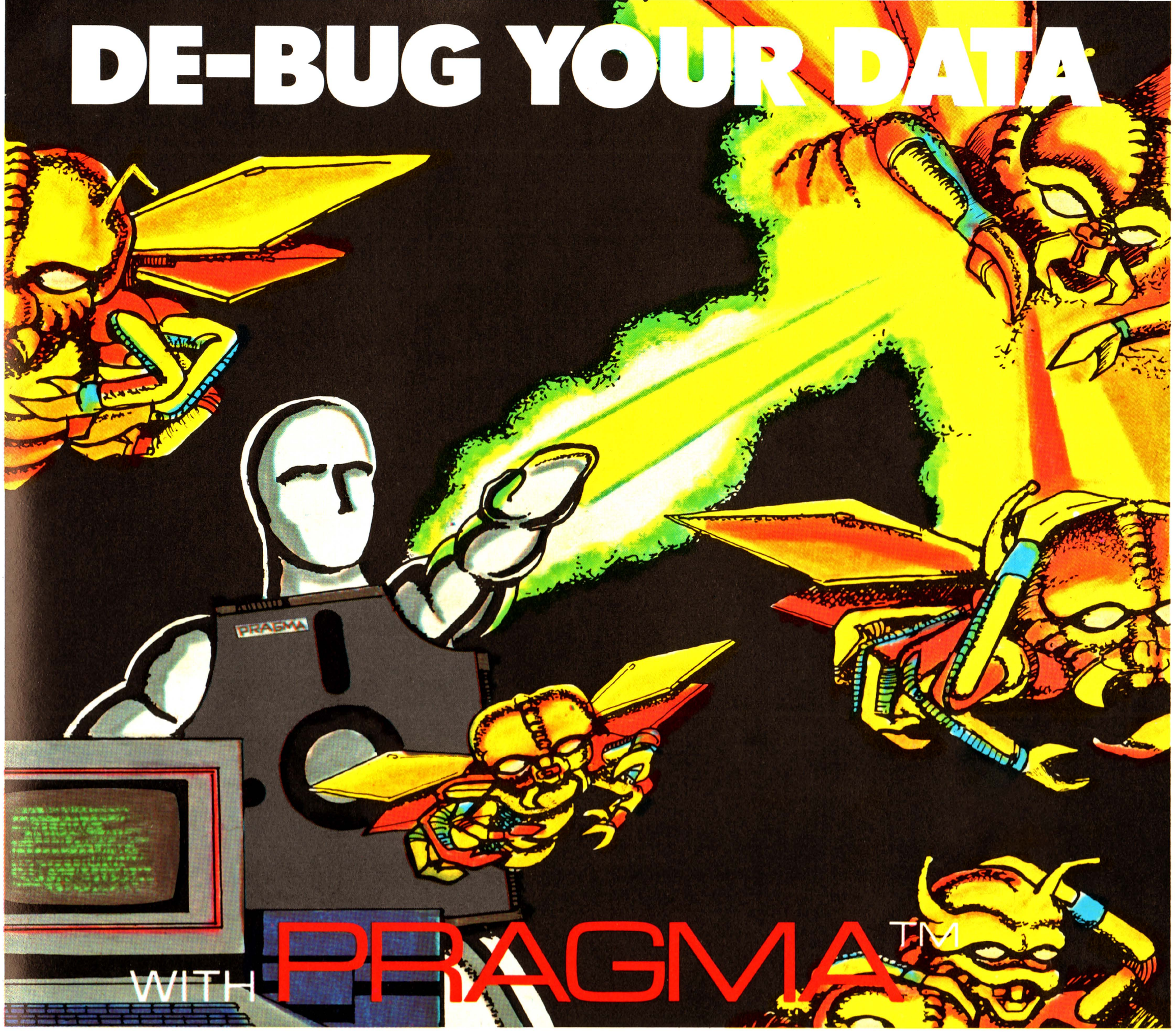

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4	24	44	64	84	104	124	144	164	184	204	224	244	264	284
5	25	45	65	85	105	125	145	165	185	205	225	245	265	285
6	26	46	66	86	106	126	146	166	186	206	226	246	266	286
7	27	47	67	87	107	127	147	167	187	207	227	247	267	287
8	28	48	68	88	108	128	148	168	188	208	228	248	268	288
9	29	49	69	89	109	129	149	169	189	209	229	249	269	289
10	30	50	70	90	110	130	150	170	190	210	230	250	270	290
11	31	51	71	91	111	131	151	171	191	211	231	251	271	291
12	32	52	72	92	112	132	152	172	192	212	232	252	272	292
13	33	53	73	93	113	133	153	173	193	213	233	253	273	293
14	34	54	74	94	114	134	154	174	194	214	234	254	274	294
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16	36	56	76	96	116	136	156	176	196	216	236	256	276	296
17	37	57	77	97	117	137	157	177	197	217	237	257	277	297
18	38	58	78	98	118	138	158	178	198	218	238	258	278	298
19	39	59	79	99	119	139	159	179	199	219	239	259	279	299
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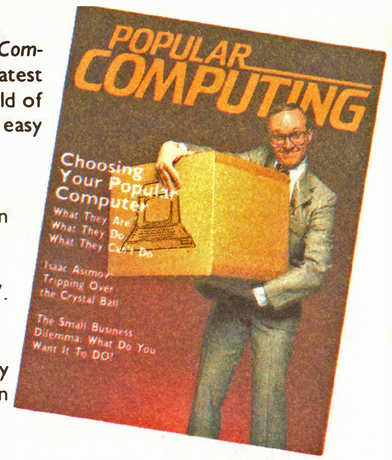

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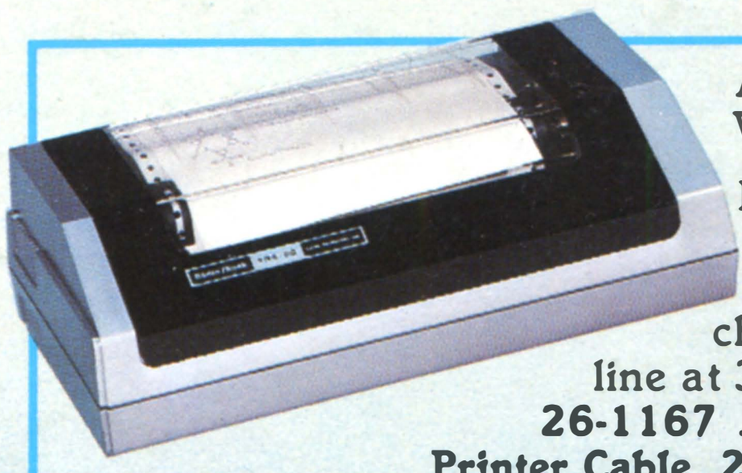

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